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SCIENTIFIC AMERICAN

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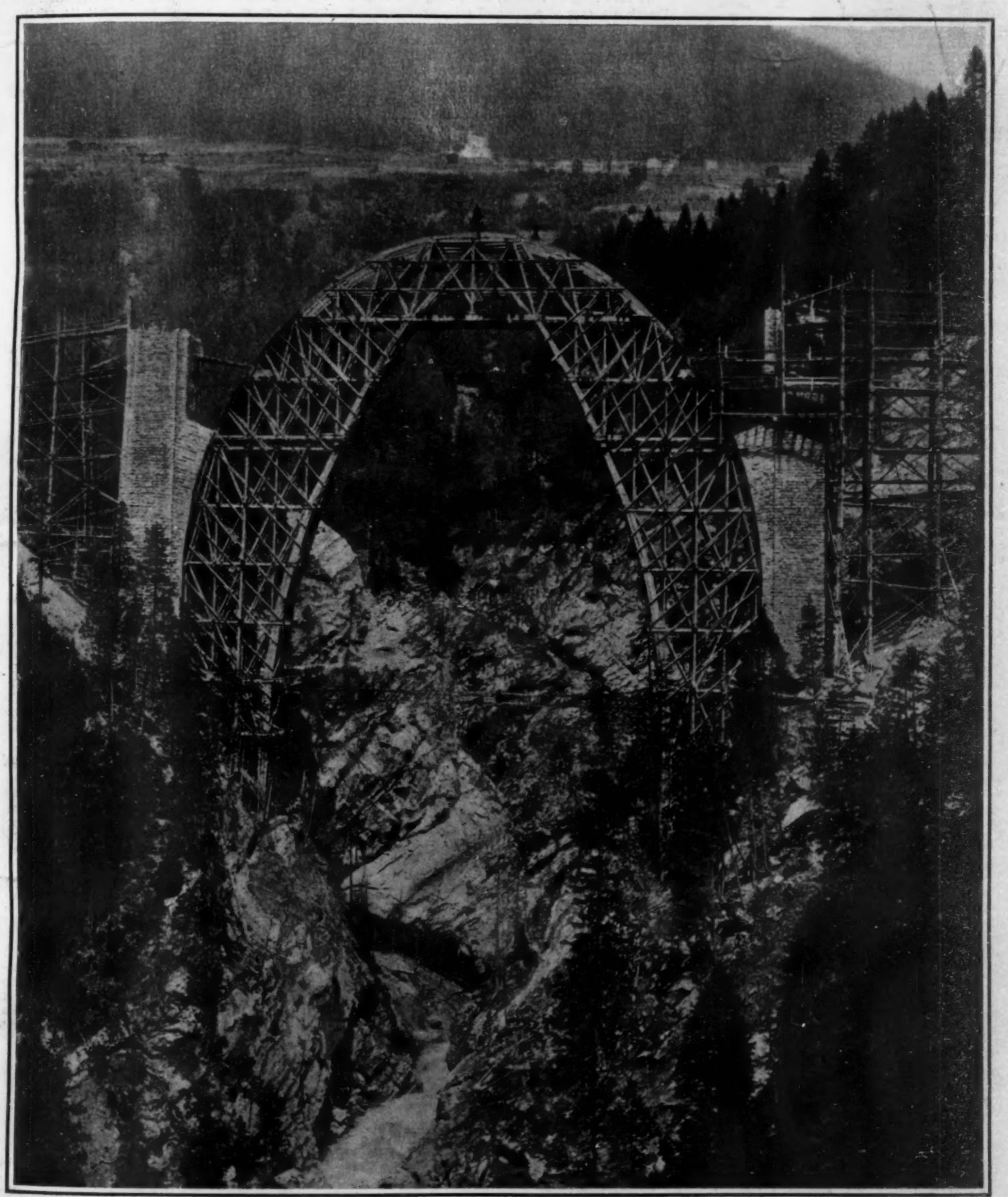

The central span is 182 feet long and towers 800 feet above the torrent below.

FALSE WORK FOR THE GREAT MASONRY VIADUCT BETWEEN WIESEN AND FILISUR, SWITZERLAND.—[See page 111.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, AUGUST 14th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

WANTED—A RELIABLE AEROPLANE MOTOR.

Unless the builders place at the disposal of the aeronaut a motor which can run with absolute reliability as long as there is a pint of fuel left in the tanks, further progress of the aeroplane, at least as regards length of flights, seems destined to be greatly retarded. Not many moons ago a 24-horse-power automobile set out upon the roads of Massachusetts to see how far it could travel without a stop. It ran ten thousand miles. To-day the aeroplane operator takes his seat, grasps his levers, and starts his engine, with the forlorn hope that it may continue to run until he has covered some modest stretch of time or space. Every moment that he spends in the air, he is watching anxiously for the first signs of that fatal "missing" which marks the probable end of his flight. Latham, with a machine which is apparently perfect in balance and control, sweeps easily through the first half of the distance across the English Channel, when, suddenly, motor trouble begins, and he must perforce float ingloriously into the sea. The Wright brothers, with an aeroplane which is the perfection of lightness, strength, and control, at the present writing have spent some weeks in Washington wrestling with the obstinacy of their motor.

Apart from its motor, the aeroplane must be considered to have already reached a high stage of excellence. Instances of failure of the planes while in the air are very rare; indeed, we do not recall a recorded instance for many months past of the failure of a flight through the breaking of the wings or body of the machine. The control, in the best machines, appears to be perfect.

Why is it, one asks, that an internal-combustion engine which will drive one machine over a continuous stretch of ten thousand miles of country without stopping, cannot drive another machine through the air without showing all the eccentric obstinacy and the hundred and one ways of breaking down which characterized the motor of the early days of the automobile? The anomaly is certainly difficult to explain; and we can only suggest a few of the conditions, which, in the aggregate, may account for the present unreliability of the gasoline motor in aerial work.

In the first place, then, many if not most of the aeroplane enthusiasts are obsessed by the fetish of "light weight"; and under this obsession they make the mistake of trying to build a light-weight motor of their own. The result is a machine which is usually too frail for its work. The problem is further complicated by the fact that this motor is mounted upon what, at best, is an unstable platform. Now, as a matter of fact, the duty laid upon the aeroplane engine is far heavier than that upon the automobile engine; for whereas the latter runs at from 800 to 900 revolutions per minute, the aeroplane motor is always being driven at its highest speed, which is usually from 1,200 to 1,400 revolutions per minute. The automobile engine is mounted on a very rigid steel frame, designed to maintain everything in true line; whereas the frame of the aeroplane is light and flexible, and where gearing is interposed between crank shaft and propeller shaft, there is a liability of the parts being sprung out of line and twisting and wrenching stresses set up. Where the engines are run at such high speed, particular care should be taken to insure that the parts function properly. Magneto ignition, forced lubrication, ample cooling surface whether by air or water, and generous bearing surfaces in the wearing parts, should characterize every aeroplane motor. Reliability rather than excessive weight-saving should be the first consideration.

The time is ripe for some firm in this country, that has had long experience in motor construction, to take up the building of motors specially suited to the aeroplane and the dirigible. These motors should embody the ripe experience and the high-class materials and careful workmanship which characterize the best automobile motor practice at the present time. There is no essential condition of the problem to prevent the construction of an engine that will drive an aeroplane in the air continuously, until the last drop of gasoline has been drawn from the tank. Practical aviation is to-day awaiting the production of a thoroughly reliable motor.

A SENSIBLE "CIVIL CALENDAR"

We have received from an advertising firm in San Francisco a copy of a proposed calendar, whose aim is to avoid the acknowledged drawbacks of the Gregorian calendar by substituting one that is better suited to the requirements of our day-by-day life. Although the Gregorian calendar dates from the year 1582, long before that many and various improvements had been suggested for conveniently dividing the 365 days of the year into weeks and months. Our correspondents ask: "Are we not again far enough advanced beyond the times of 1582 to adopt certain other changes?" and they offer a calendar which divides the 52 weeks of the year into 13 months, each having exactly 28 days. The first of January and the first of every one of the twelve succeeding months fall on a Sunday, and the 28th or last day of each month, therefore, falls on a Saturday. The obvious advantage of this arrangement is that, since each day of the week must be one of four numbers out of the 28 (Sunday for any month of the year being either the 1st, 8th, 15th, or 22nd, Tuesday either the 3rd, 10th, 17th, or 24th, etc.), if one knows the day of the week, it is possible to find the day of the month quickly and without reference to a calendar.

The additional month necessary under this system is named by its sponsors "Vincent"; and it is placed in the calendar between June and July.

Thirteen months of 28 days each, however, give a total of only 364 days for the year, and, to accommodate the odd day, it is proposed that between Saturday, the last day of December, and Sunday, the first day of January, there should be a day to be known as "Anno Day." It is not recognized as a calendar day, and beyond its name, has no other distinction to separate it from the last day of December. Any labor done on Anno Day would have to be a matter of special contract or agreement. No interest or rental will accrue upon that day, and for all such purposes it would be considered a part of Saturday, December 28th. Leap Year is provided for by an extra day between Saturday, Vincent 14th, and Sunday, Vincent 15th. This would be known as "Mid-anno Day" and it would be treated in all respects similarly to Anno Day.

Although there can be no question of the simplicity and convenience of the proposed calendar, in respect of any prospect of its immediate and world-wide adoption, we fear it must be classed with those two other great desirables, the "metric system" and the "longer daylight day." We are not more firmly convinced of the advantages of this and those propositions for simplifying and rendering easier and more pleasant the round of daily life and its duties, than we are that to bring about these suggested improvements will take many years of arduous and persistent agitation.

MEDIEVALISM IN MODERN CHEMISTRY.

In the Revue Générale de Chimie Pure et Appliquée, Gustave D. Hinrichs publishes an article in which he criticises severely the return of modern chemistry to medieval ideas—in Hinrichs's opinion, medieval error.

While one cannot but regret the intensely acrid tone in which the author writes, and the almost directly personal character of some of his remarks, one is forced to admit that there is some justification for his criticism. At the same time Hinrichs's article draws attention to some really very interesting parallelisms between the ultra-modern conceptions of chemistry and certain dicta of the ancient alchemists. Thus he quotes from Berthelot's work "Les Origines de l'Alchimie" (1885), the following passages: "According to the view of the alchemists, lead was the parent of the other metals. From it were produced the three metals copper, tin, and iron."

"From lead also silver was made. This idea must have seemed quite natural to the ancient alchemists, who recovered silver from argentiferous lead by cupellation."

Again, in his work "Archéologie et Histoire des Sciences" (1906), Berthelot quotes from Chinese writings:

"There are some who say that *tan cha* absorbs the vapors of green *yang* (orpiment), giving rise to a mineral, called *kong che*, which in the course of two hundred years becomes converted into native cinnabar. After two hundred years more this cinnabar changes into silver, and this after the lapse of another two hundred years, under the action of *Ki* or *ta ho* (the Great Unity), is turned into gold." Compare with this the statements of Ramsay before the French Association for the Advancement of Science, in 1908:

"Helium is the gaseous product of radium emanation."

And again:

"In the presence of water neon is produced; copper is changed into lithium."

And, more particularly with reference to the passage quoted above from a Chinese author, note the following *résumé* of the modern doctrine, as expounded for example by Arrhenius in his book, "Theorien der Chemie.":

The transmutation of radium comprises the following series of steps:

I. Radium undergoes gradual disintegration. In 1,300 years it is reduced to one-half its original amount, giving rise to

II (*a*) An emanation, which in the course of 4 days produces:

(*b*) Radium A, which in turn splits up, in 5 minutes, with formation of

(*c*) Radium B; this again, in 21 minutes forms

(*d*) Radium C; in 28 minutes this latter gives

III (*e*) Radium D. The substances radium A, B, C, D are solids, and are transformed in 40 years into

(*f*) Radium E. This in 6 days generates

(*g*) Radium F, probably identical with polonium. In 143 days this decomposes into

(*h*) An inactive substance, of which it is unknown whether it is subject to any further transformations.

In the same work the time required for the transmutation of uranium into radium is given as 2,500 million years. This gives for the entire series of transformations 2,500,001,300 years, 153 days and 54 minutes.

Hinrichs here criticises the spurious appearance of great exactitude which is given by this statement to the minute of a period embracing millions of years. In point of fact this criticism is based on a peculiar misunderstanding, for while we may know a period of six minutes, say correctly to the minute, the statement of the longer periods obviously cannot be accurate to nearly such a small interval of time, and there is evidently no justification for adding together, as Hinrichs does, the successive periods in order to obtain the aggregate period. For the lesser intervals fall far within the range of the error in the estimation of the long period of 2,500 million years, and are simply negligible in comparison with it.

As for Ramsay's statement with regard to the transmutation of copper into lithium, attention is justly drawn to the recent experiments of Madame Curie, which seem to conclusively refute Ramsay's views. For Madame Curie has shown that if the work is carried out with scrupulous care, in platinum vessels (instead of quartz, as used by Ramsay), there is no sign of any "production" of lithium. Hartley also has shown that both quartz and copper, and in fact practically all minerals, contain lithium.

Hinrichs's paper contains many other criticisms, some of which appear, perhaps, hardly justified. We have selected for presentation here only some of the most valuable and interesting suggestions in an article written in a destructive rather than constructive spirit.

KEEPING MILK BY CHILLING IT.

One method of keeping milk consists in sterilization by heating to 230 deg. F., but this process changes the flavor of the milk, renders it indigestible and alters its chemical composition. Pasteurization at 176 deg. F. and simple boiling at 212 deg. F. are less objectionable, but although the germs of disease are destroyed by these methods other microbes are not destroyed and the milk, consequently, does not keep very long. Freezing is seldom effective because of the difference in the freezing points of the various constituents of the milk, so that when the milk is melted it does not possess its original uniform and homogeneous character. Cooling to a temperature slightly above the freezing point has the advantage of leaving undisturbed the homogeneity, flavor, digestibility and nutritive value of the milk, and when the cooled milk is again warmed to the temperature of the air it is found to have undergone no alteration that can be detected by the microscope or chemical or biological tests. Besides, the cooling checks the multiplication of bacteria. The milk should be cooled immediately after it is drawn, or after pasteurization or boiling if these processes are adopted. When the milk is cooled to 35½ deg. F. it may be kept several days at any temperature lower than 53 deg. F.

The annual prize of $5,000 instituted by King Leopold of Belgium in 1874, will, for the year 1911, be awarded for the best work in French, Flemish, English, German, Italian, Spanish or Portuguese on "The progress of aerial navigation, and the most effective means for its encouragement." The works submitted for competition must reach the Belgian Minister for Science and Art before March 1st, 1911.

ENGINEERING.

The War Department is greatly pleased with the result of the recent practice with heavy coast-defense guns at Fort Monroe. Five 12-inch and two 10-inch rifles were fired at a moving target 30 feet high by 60 feet long, which was towed past the fort at a speed of seven miles an hour. Twenty-four projectiles were fired in 2½ minutes and 18 hits were made. Since a modern battleship is from 400 to 500 feet in length and from 20 to 28 feet in height, it is considered that, had the firing been at a battleship instead of the canvas target, every shot would have found the mark.

The science of aeronautics, in addition to rapid recent developments in practice, is beginning to co-ordinate the results of tests and reduce them to formulæ. A paper by M. D. Drzewiecki in Comptes Rendus gives some rigorous formulæ connecting thrust, carrying power, speed, surface, and incidence. The minimum power per weight carried is obtained when the loss due to friction and the passive resistances is one-third of the resistance due to incidence. The author claims that none of his formulæ are based on unproved hypotheses but upon direct experiments under varying conditions.

The railroads of the United States have ever been famous for the great size and carrying capacity of their rolling stock. Nowhere in the world are such heavy passenger and freight trains hauled as in this country. Not long ago a train 3,000 feet long, containing 85 cars loaded with 4,451 tons of coal, was hauled from Altoona to Enola, Pa. Trial was made to determine what loads could be moved over the middle division, where the maximum grade has recently been cut down to 0.2 per cent. The train was hauled for 124 miles at an average speed of 17 miles per hour by a single freight locomotive.

The loftiest chimney in the world was recently put into service at the large smelting works at Great Falls, Mont., where it will serve to carry off the gases from the greater part of the large plant. The chimney, which is built of brick, is 506 feet in height above the ground. It is 50 feet in diameter at the top, and increases gradually in diameter to the base. The flue includes a dust chamber in which vertically-hung wires serve to take out the dust from the smoke. The dust is removed from the wires by shaking mechanism and falls in hoppers in the floor, from which it is loaded into cars in a pit below.

We note in a recent copy of Peru To-Day that the survey is shortly to be undertaken for a railroad, which will exert a most important influence on the commercial development of Peru. The line will start from the port of Paipa, one of the best harbors on the west coast, and will be carried across the lowest divide to be found in the whole of the Andes range in South America, the summit level being only seven thousand feet above the sea. This is less than one-half the elevation of the summit of the two existing trans-Andean railroads in Peru, one of which is 14,436 and the other 14,765 feet above the sea. When the line is built, east-bound freight from the coast of Peru, which must now make the circuit of South America and often go to Liverpool to reach its destination, will be carried directly across the mountains to Iquitos, the head of navigation on the Amazon River.

Railroad engineers are becoming increasingly alive to the importance of building both track and rolling stock with reference to the heavy centrifugal forces which are brought into play when heavy trains are run at express speed around curves. These stresses are particularly severe in the case of heavy electric locomotives built for use on steam railroads. We have always believed that the wreck at Woodlawn near this city was due to a conjunction of low center of gravity in a heavy electrical locomotive, high speed, and insufficient elevation of the outer rail of the curve on which the accident happened. To prevent "nosing" or side oscillation, the New Haven electric locomotives have been provided with end pony trucks, and the New York Central locomotives with four-wheel trucks. In both cases the improvement in the running has been very marked.

As we recently remarked, it has been claimed on good authority that all boiler corrosion is traceable to galvanic action. A paper recently read by Mr. G. N. Huntley before the Society of Chemical Industry on investigation of the cause of pitting in a stand-by boiler seems to prove that sulphur is an important factor in some cases, which hardly coincides with the electrical theory. An increase in the proportion of caustic soda used had no effect, and blisters were found, especially near the water-line, which, on being pricked, were found to contain liquid with a fine black powder in suspension, consisting of ferrous sulphate with a slight excess of sulphuric acid, while the boiler water was slightly alkaline. It would seem that sulphur in the water is first oxidized to free sulphuric acid which attacks the metal in its neighborhood, the deposited oxides forming a membrane permeable to oxygen but not to alkali, and permitting the curious acid corrosion in alkaline water.

ELECTRICITY.

The city engineer of Toronto, Canada, will shortly call for bids for an electrical pumping plant aggregating 13,000 horse-power.

A long-distance telephone service with four lines is expected to be opened next year between London, Paris, Madrid, Barcelona, and San Sebastian.

According to the Times (London) the Canadian Pacific Railway will grant use of its right-of-way for a special wire forming the connecting link between the Atlantic and Pacific cables of the proposed all-British round-the-world system.

A French inventor, M. Gabet, has recently made successful experiments in the Seine with a torpedo which he can start, stop, and steer electrically by wireless apparatus on land or in a boat. He expects eventually to control the torpedo for a range of eight miles.

Tests are being made at Brant Rock, Mass., of the apparatus to be installed at the 1,000-foot tower to be erected at Washington. The Navy Department specifications require that it shall be sufficiently strong to send messages 3,000 miles and receive them from the same distance.

Electrification of the Grand Trunk Pacific Railway from the St. Lawrence River to Monckton is being considered. A water-power site capable of generating upward of 100,000 horse-power, greatly in excess of the requirements, has been selected at Grand Falls on the St. Johns River, nearly equidistant from the two points between which electrification is proposed.

Among interesting papers read before the Royal Society in London recently was one by C. Russ upon the electrical reactions of certain bacteria as applied to the detection of tubercle bacilli in urine by means of an electric current. Another by Prof. H. A. Wilson described his experiments to determine the effect of a magnetic field surrounding it upon the electrical conductivity of a flame.

A patent recently granted to Mr. A. F. Rietzel is expected to overcome the difficulty often encountered in electric welding due to the arc jumping at the nearest points of two not quite smooth surfaces, and the exact position of the weld not being easily controlled. Raised portions on both sheets to be welded are placed in contact with each other, and the welding temperature reached only at the points desired, with a result similar to riveting, a saving of electrical energy, and elimination of burning of metal resulting.

The Electrical World calls attention to the great superiority of the electric to the gasoline automobile for city use, with especial reference to the anti-noise campaign. The distracting noise of the latter is sufficiently familiar—to an invalid confined to the city, for instance—the occasional startling explosion in the muffler of a charge which has missed fire, the screech of changing gears, not to mention the smell. None of these disadvantages apply to the electric vehicle, which also avoids the opprobrium directed against reckless driving, the electric motor being equally applicable to a light runabout which a woman or child can operate, or to a heavy commercial truck.

The generation of electricity by aermotors, or "wind turbines," as they call them, is making great progress in England, as shown by an exhibit at the seventieth annual show of the Royal Agricultural Society at Gloucester. The exhibit included a 24-foot turbine on a 60-foot steel tower driving a variable-speed generator with considerable excess storage-battery capacity to provide for calms. Current was supplied for an electric grill, kettles, irons, and fans, as well as a butter churn, a cream separator, a circular saw, and a deep-well pump. By division of the storage battery into two parts it is possible to use 50-volt current for driving the machines and 25-volt current for lighting, the latter permitting the use of metallic-filament lamps.

An interesting article by a lady contributor to the London Electrical Review describes the lighting of an eight-room suburban English home at a cost of $18.75 a year, which is further reduced by saving made in other directions over coal and gas for heating and other purposes. The parlor and dining room have two and one 50-candle-power lights respectively, costing 6 cents each for 16 hours' service, as compared with 7½ cents each for incandescent gas burners of lower power for the same time. The life of curtains, draperies, and plants in the rooms is said to have been twice as long as under the previous gas *régime*, a saving of 12 cents a week for cut flowers alone having been made. Painting and papering had to be renewed only once in four years with electric light as compared with every two years with gas, a saving of two dollars per room per year. Electric heaters in the living rooms cost 24 cents per 12 hours each at maximum capacity, which can be reduced when the rooms are warm enough, against 36 cents for gas fires or 19 cents for coal fires, comparing favorably even with the latter when the elimination of cost of cleaning and attendance is considered.

AERONAUTICS.

A new use for balloons is proposed by W. D. Boyce of Chicago, who sailed recently for East Africa in pursuit of natives and big game, which he will hunt not with the rifle but the camera. His idea is to attract wild animals in their native haunts by a light suspended from a balloon, and photograph them in such natural surroundings by flashlight.

Authority has been given by the War Office for the leasing of certain ground near Washington for use as a training ground for officers of the United States army in the use of flying machines. The first officers selected for instruction will be trained by the brothers Wright personally, and they in turn will teach others. A level tract of 163 acres almost free from trees has been chosen, so that the practice of beginners may be made at a height of 20 feet or less from the ground, eliminating as far as possible the danger of serious accident.

On the 6th instant Glenn H. Curtiss, who, since his 52½-minute flight at Mineola, L. I., on July 17th, is the record holder of the SCIENTIFIC AMERICAN Trophy, sailed for France with a new and untried biplane similar to that which he sold to the Aeronautic Society. Mr. Curtiss will be America's sole representative in the international aeroplane race for the Bennett trophy at Rheims on August 29th, and he will also compete in several of the other contests to be held during the week of August 22nd above the plains of Betheny in the champagne country.

Messrs. Baldwin and McCurdy, the two Canadian engineers who were formerly associated with Dr. Bell, are carrying on experiments at the Petawacon Military Camp, which is about 100 miles from Ottawa, Canada. On August 2nd they tried a new 40-horse-power motor on the "Silver Dart," the last aeroplane of the Aerial Experiment Association. After making several excellent flights of half a mile each with both men on board, the rays of the rising sun dazzled the aviator so that he steered down too soon, struck a knoll, and damaged the machine. This is the first time on record that the "Silver Dart" has carried a passenger. The speed attained is said to have been over 40 miles an hour. The motor has been placed in a new biplane built for the Canadian government and known as "Baddeck No. 1." If the flights with this are successful, it will probably be taken to England and demonstrated for the British War Office. According to the Minister of War, $390,000 will be spent during the next year for aeronautics in the army.

The Aeronautic Society's aeroplane which was badly smashed on the 18th ultimo, when a member, Mr. Alex. Williams, was taking his first lesson, has been repaired again and tried by Mr. Curtiss preliminary to his sailing. Mr. C. F. Willard, who had made one short flight before the machine was damaged, is taking advantage of all quiet mornings and evenings to make practice flights. As soon as he has become proficient, he will make exhibition flights in various parts of the country. At the Society's meeting on August 5th Mr. José De Viñez gave an interesting talk on model aeroplanes. He exhibited and flew several novel toys which he recently brought over from France. He expressed surprise at the slowness of America in catching the aviation craze. In Paris the children are all building and flying models, from which, as he demonstrated from small paper models made on the spot, much can be learned. It was a toy French flyer, it will be remembered, that first aroused interest in the Wright brothers.

The international aeronautical exhibition at Frankfort-on-the-Main, Germany, was opened a month ago, but nothing startling happened until the arrival of the "Zeppelin II." airship on July 31st. The 220-mile trip from Friedrichshafen on Lake Constance was made in about 11 hours. The start was made by moonlight at 3:40 A. M. and the first 56 miles to Ulm were covered in 1 hour and 39 minutes, an average speed of 42½ miles an hour. Then a violent head wind sprang up and 5 hours was consumed in covering the next 58 miles. Near Geislingen no headway was made for 25 minutes. The machinery worked perfectly throughout the trip, and the landing was made on a selected spot amid the plaudits of thousands. On July 28th at Friedrichshafen a severe test was made in which the airship rose to a height of 3,000 feet in a thunderstorm. On August 2nd a trip to Cologne, 110 miles distant, was attempted. When within 30 miles of that city a severe wind and hail storm was encountered, and the airship retraced its course at a faster rate than such a vessel has ever traveled before. A broken propeller the following day put an end to the second attempt immediately. At 4:40 A. M. August 5th, however, another start was made, and at 10:15 the airship appeared at Cologne and circled the spire of the cathedral. The trip took two hours longer than expected on account of fog. A landing was made in the suburb of Bickendorf. The same day the "Gross II." made a round trip from Berlin to Halle (217 miles) in 15 hours and 40 minutes, an average of 13.85 miles an hour.

SOME ACOUSTIC EXPERIMENTS.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Tyndall has shown that ordinary fabrics are permeable to sound as long as they are dry but lose that property when they are soaked with water. The quickest way to make the experiment is to submerge one-half of a bed sheet in water and then interpose it between the ear and a watch held close by, as shown in the illustration. The tick-tack is easily heard through the dry part of the sheet but the wet region intercepts the sound. If both ear and watch are placed on one and the same side of the sheet, the contrary takes place; the wet sheet reflects the sound, which becomes distinctly louder than when the watch is held close to the dry part of the fabric. Advantage may be taken of this fact to repeat, without apparatus, a classical and pretty experiment usually made with two large concave mirrors.

Two umbrellas are thoroughly moistened and laid horizontally some 15 to 20 feet apart, with the two rods in alinement. This last condition, which is essential, is easily fulfilled by laying the umbrellas as shown with the point of the rod resting on the back of a chair while the handle is loosely tied to a vertical stick stuck into the ground. The chair may be moved laterally; the handle may be run vertically along its support; the umbrella rod may thereby be set at any desired angle. A white thread is stretched between the two umbrellas, and the rods are set parallel to the thread. This is then cut and removed.

If now two experimenters (one for each umbrella) place either mouth or ear in contact with the rod and at from two to three inches from the sliding sleeve, any word uttered in a low tone, in the direction of the umbrella, will be distinctly heard in the other umbrella. The voice, however, will not seem to come from the direction of the speaker, but from the opposite side; that is, it will be perceived by the hearer as if the words were uttered in the hollow of his own umbrella by some invisible being. Moreover, a third experimenter, placed between the other two, but somewhat outside the straight line uniting the two umbrella rods, will not understand a word of the conversation thus carried on, though he is but half as far from the speaker as the hearer is.

Owing to the large size of the reflectors, the experiment is always successful; but if it lasts more than a few minutes care should be taken to sprinkle water over the umbrellas from time to time.

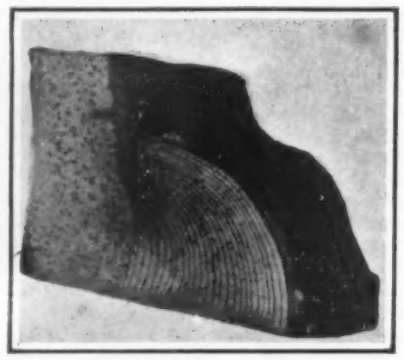
My friend, Prof. Tristán, who takes much interest in the teaching of science in common schools, has found another and still easier way of performing the same experiment. A watch is held about two inches above a common soup plate, which reflects the sound waves and decreases their divergence. Another soup plate, kept close to the ear, at an angle of 45 deg. with the direction of the sound waves, causes them to converge into the ear. The loud tick-tack does not seem to come from the watch but from the plate kept close to the ear. It ceases when the two plates are withdrawn.

At the International Congress of Applied Chemistry, held in London recently, Mr. Samuel R. Tucker presented a paper dealing with "The Relative Efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide." Calcium carbide was prepared in two types of furnaces under conditions which would give the best yield. Comparison was made of the product as to its carbide content and its weight obtained per energy unit. The results showed that, for the scale on which the experiments were conducted, the resistance furnace was much superior to the arc. The best result obtained with the arc furnace was 1,170 watt-hours per 100 grammes of pure carbide, while with the resistance furnace the same quantity of pure carbide was obtained with 544 watt-hours. The best proportions of lime and coke to be used with the two types of electric furnace employed were also given.

ASKING THE TREE TO SPEAK.

BY CHARLES E. COOKE.

Under our system of land surveys, the country is being divided into square miles. These divisions are known as sections, and along the lines marking them are established corners at half-mile intervals. The method of marking these section lines varies slightly according to the nature of the country over which the survey is made, but in a majority of cases a rock of the dimensions prescribed by law is placed in the ground at each corner and is known as a corner stone. When these section lines are surveyed through timber, it is required also that trees in close proximity to the corner should be marked, giving the township, range, and section which that particular corner represents. These are termed bearing trees, and are to aid in the subsequent relocation of the corner stone in the event that it is ever destroyed or removed. Furthermore, it is required that trees along the line of survey should be marked. This is accomplished by chopping off a small portion of the bark on two sides of such trees as are close to the line. This is known as the blazed line, and if well marked can be easily followed even many years after the original work is done. Once in this line, the task of finding the corner stone is simplified; and unless every vestige of it has disappeared, together with the bearing trees relating to it, one is pretty sure to find it. However, in a great many instances these blazed lines are hard to identify. So many years have elapsed since the blazing was done that the bark has completely grown over, or forest fires may have so injured the trees that only here and there one remains to show where the ax has been. Then, again, nearby lines that have been blazed for other purposes are confusing, and oftentimes one follows them up, only to find them terminating at some point in which he has no interest.



A SECTION CHOPPED FROM PINE TREE.

Showing original blaze and twenty-five years' growth since.

The accompanying illustration shows how, in this latter contingency, the line one is looking for may be distinguished from others, provided the year in which the survey was made is known. It represents a section chopped from a pine tree, and shows the original blaze and the growth of the tree since.

During the past year, while hunting for section corners in Colorado, which had been established in 1883, great difficulty was encountered in locating the proper lines, owing to the presence of numerous other blazed lines to mining claim corners, prospects, etc. In order to determine whether or not a certain line was the correct one, a section would be chopped out of one of the blazes, and the rings appearing in it counted between the blazed scar and the bark. Allowing one year's growth of the tree for each ring found, it was readily determined whether or not the years which had elapsed since the blazing had been done corresponded with the number of years since the survey looked for had been made. In this way it was possible to locate the section lines, and once on them, little trouble was experienced in finding the corners.

The section seen in the illustration was cut from a tree along the line of survey sought, and shows twenty-five rings, which growth identifies the work as having been executed in 1883.

The Visibility of Stars in Daylight.

The blue light of the sky, which prevents us from seeing the stars in the day time, is strongly polarized. According to the experiments of Cornu, the proportion of polarized light may amount to eighty per cent when the air is very clear. The light of the stars, on the other hand, is not polarized. If the polarized light of the sky is cut off by a Nicol prism, it is evident that the apparent brightness of the star will be increased in respect to the brightness of the sky. Hence the star will become more visible, and an ordinarily invisible star may be seen.

This method would be particularly advantageous for the observation of circumpolar stars. These stars are situated at an average angular distance of 90 degrees from the sun and are, therefore, in the best conditions for observation, as the proportion of polarized light is a maximum at this angular distance. Furthermore, one of the two meridian passages always occurs in daytime, and the observation of both passages is of great astronomical importance. It is singular that this very simple method, which has been suggested by Salet, is not employed in these observations. Salet shows that, by this use of the Nicol, the power of a telescope may sometimes be made equal to that of an instrument of twice its aperture without a Nicol. Consequently, the value of meridian observations, especially in determining latitude, may be greatly increased. Long ago, Arago proposed to use a tourmaline in order to perceive reefs in a calm sea amid the glare of reflected light, by which they are masked. Hagenbach suggested a similar process for eliminating the bluish haze which veils objects near the horizon. Salet, who recalls these facts in the Bulletin Astronomique, states that the employment of the Nicol prism in astronomical observations by daylight has not hitherto been practised or even proposed.—Cosmos.

Soup plates as sound reflectors.

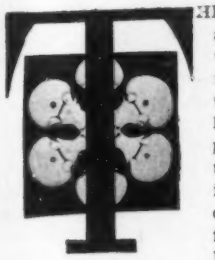
The wet cloth intercepts the sound.

The man between the talkers cannot hear the conversation.

SOME ACOUSTIC EXPERIMENTS.

MARVELOUS PAINTINGS OF NATURE.

BY DR. ALFRED GRADENWITZ.



THE novel scope of Nature's artistic work was recently revealed by the marvelous decorative patterns exhibited at the annual show of the French Physical Society. The photographs accompanying this article give only a faint idea of their splendor and delicacy of shading. So far from being drawn by the hand of a skilled and imaginative artist, these patterns had been created by Nature in Prof. St. Leduc's physical laboratory at Nantes.

As our readers will doubtless recall from previous articles, Prof. Leduc has been engaged for many years in investigating what is called osmotic pressure, or the force of diffusion. This force, with which lay people are relatively unfamiliar, plays an all-important part in connection with vital phenomena. It drives the humors of plants and animals through their vessels and pores. According to the views held by the French experimenter, it even determines the forms of vegetable growth. In fact, Leduc has succeeded in producing by simple diffusion experiments the most varied artificial plants, of which we illustrate some particularly beautiful, recent samples.

The decorative patterns forming the main subject of the present article are indebted for their existence to the same force of nature which manifests itself wherever solutions of different concentration are separated by a porous partition, bringing about a motion of liquid, until a perfect equality of concentration is produced.

The following particulars will enable any amateur to obtain these figures of diffusion: On a glass plate are poured out five cubic centimeters of a 10 per cent gelatine solution to which has been added a drop of a saturated solution of different composition (preferably ammonium chloride, bromide, or iodide). On the gelatine thus prepared are arranged symmetrically drops of various solutions, such as calcium nitrate, silver nitrate, potassium citrate. If this plate be allowed to rest on a horizontal surface, the liquid drops are seen to diffuse gradually, generating the most surprising effects of form and color. Care should be taken to protect the plate when drying against any shock. The resultant picture is glued on pasteboard, like a photographic print, for use as a decorative pattern.

Certain substances will produce by their diffusion lines of equal distance, alternately transparent and opaque, the thickness of which lines varies from some tenths to less than 1/1,000 of a millimeter. If their thickness is between 1/100 and 1/1,000 millimeter, the patterns are full of networks of lines, and rectilinear or circular gratings, giving the most splendidly colored diffraction spectra.

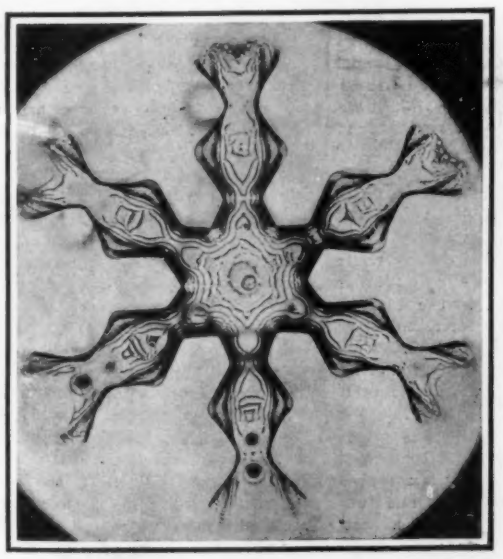
These gratings are obtained with a large number of substances. Very beautiful samples are produced by allowing a mixture of saturated solutions of potassium phosphate and carbonate in equal parts to diffuse. In fact, the effects thus obtained are quite similar to the scintillation of mother-of-pearl.

As Leduc points out, all living tissues show the same network structure. In fact, not only in mother-of-pearl but in the wings of beetles, feathers of birds, muscles and sinews of man, and in many other living substances, the same structure and color effects, whose production no physical force so far sufficed to explain, may be observed.

Plant-like forms obtained in Leduc's experiments with osmotic pressure.

In addition to its scientific interest, the process above described is obviously of the highest practical importance. It renders it possible to reproduce the most delicate photographs by coating the gelatine of the photographic plate at 35 deg. C. with a gelatine layer, containing traces of calcium nitrate on which drops of a mixture of calcium phosphate and carbonate are spread out.

In order fully to account for those strange phenomena, the hypothesis should be made that diffusion occurs not continually, but periodically at given intervals of time.



Other forms of plant-like structure obtained by Leduc.

Dentists have made the startling disclosure that they can alter and enlarge the jaws in any child by simple means, and they have found that the teeth themselves and their arrangement are the pattern from which the jaw takes its shape. Three people out of four seem to lack in the proper development of the lower portion of the face by reason of defective and misplaced teeth and weak and ill-developed jaws. Hence we deduce that the "man of destiny," "the man with firm jaw who knows his own mind," is presumably one who was made to chew properly in childhood, and was not allowed to shove down his food half chewed or unchewed by gulps of liquid.—Popular Science Monthly.

Kieselguhr.

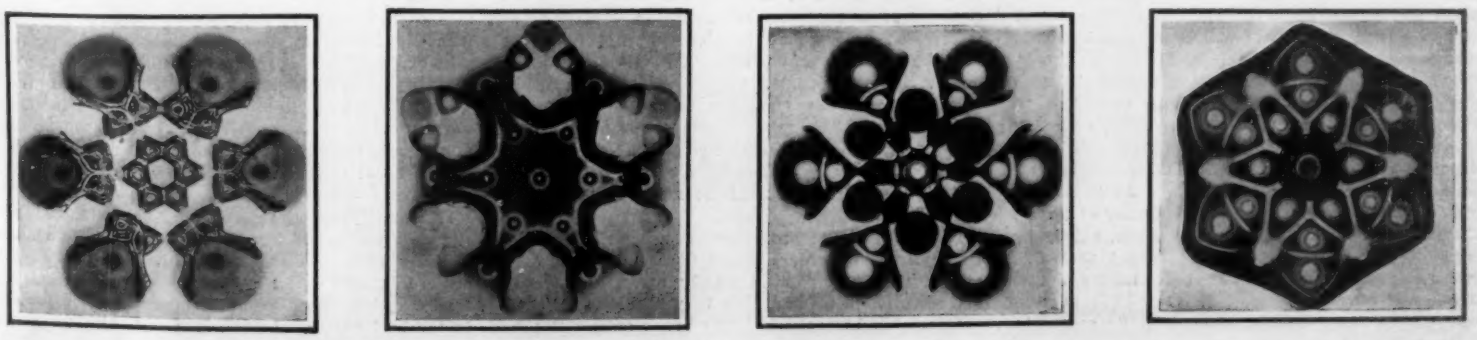
Kieselguhr is a variety of infusorial earth, which is used as a filler for soap, sealing wax, paints, and other products, and employed in the manufacture of dynamite, alizarine, soluble glass, cements, artificial stone, articles of gutta percha and India rubber, and for many other purposes.

Kieselguhr is found in large quantities in Hanover, where it occurs in gray, brown, or pale green layers in alluvial deposits and near beds of lignite. It is soft and dry to the touch, absorbs water very readily and is not affected by chemical reagents at ordinary temperatures. Kieselguhr is found also in Hesse, Hungary, Bohemia, Tuscany, Sweden, Finland, and Canada.

The valuable properties of kieselguhr are its low specific gravity (0.25 to 0.55), its great power of absorbing water, and its low thermal conductivity, which make it one of the best known heat insulators.

It is extracted from open pits, spread on planks on the ground, and left to dry under the action of the sun and the wind. Artificial desiccation has not proved practically successful, according to a report of the American consul at Hamburg. Drying in ovens presents no difficulty, but also no particular advantage, and has never been attempted on a large scale. (Kieselguhr is quickly calcined by contact with flame.) Various mechanical drying processes have been tried and abandoned, in Germany. Drying by a blast of hot air has been employed to some extent, but only in wet seasons, or after partial drying in the usual way. The method is too expensive for use except for the best grade of kieselguhr, which is employed in making dynamite, and when the market price is unusually high.

Kieselguhr, as it is taken from the pit, contains from 70 to 90 per cent of water, which evaporates very slowly. Air-dried kieselguhr retains from 15 to 25 per cent of water. The dried kieselguhr is ground and packed in bags. During transportation and storage it must be carefully protected from dampness.—Cosmos.



Symmetrical designs obtained on glass plates by Leduc in experimenting with osmotic pressure.

MARVELOUS PAINTINGS OF NATURE.

HALLEY'S COMET.

BY DR. ALEXANDER W. ROBERTS.

Already in the pages of this magazine reference has been made to the approach of Halley's comet, the most important astronomical event of the years 1909 and 1910. Every seventy-five or seventy-six years this remarkable body completes its far-stretching and extremely elliptical orbit round the sun.

When the comet sweeps round the sun at its nearest approach, or perihelion, it passes within the earth's orbit; while at its farthest reach, or aphelion, it lies outside the confines of the solar system. Thus during the greater part of its long journey, for at least seventy-three years out of the seventy-five, or seventy-six, it is invisible in even the most powerful telescopes. It is then describing that portion of its path which lies outside the orbit of Jupiter. When, however, it is within the orbit of this planet, it is near enough to our earth to be visible in our evening or morning skies.

At first, on its sunward flight, it is discernible only as a faint telescopic object, but each day witnesses its increase in brightness, till at length it is visible to the naked eye, is, indeed, conspicuous enough to compel the gaze of even the indifferent beholder. As a rule it is easily seen by the unaided eye for some months.

After passing its brightest phase—which it will do this cycle in the first week in June, 1910—it rapidly decreases in brightness and is soon lost to view in even the largest telescopes.

It was last seen at the Cape Observatory in May, 1836, passing after that date into the far distances from which it came. But although it vanished from the sight of men, its onward track through space was known with as great accuracy, relatively, as sailors know the way of a ship over the trackless deep. And thus every lap of its vast orbit, over three thousand million miles distant, at its widest reach, from our earth, has been mapped out with the utmost care, and with assurance. Unseen for seventy-three years, it is yet as surely seen by those who make this branch of astronomy their care as if it shone brightly and continuously in our midnight sky. The invisible bonds of law have it in their inexorable hold, and from out the confines of that unbreakable leash it can never, never pass.

In the accompanying figure are given positions of the comet at various dates along the 1835-1910 cycle.

We have already said that the comet was last seen in May, 1836. It was then moving swiftly away from the sun, midway between the orbits of Mars and Jupiter. In the early days of 1837 it crossed the orbit of Jupiter. Jupiter himself was not very far away when the comet passed under his line of march. Slowing now down considerably, the year 1838 is well advanced before the region of Saturn's sway is reached. In six more years Halley's comet is as far distant as Uranus, and in twenty more years it is out beyond the farthest planet. And now, like a great, stately ship wearing in midocean, the comet slowly sweeps round in its orbit. Its long outward flight is spent, and the conquering homeward pull draws it sunward again. The year 1872 marked the comet's farthest distance, its aphelion; after this date its return journey begins.

At the opening of this century it was again within the orbit of Uranus. By the end of 1907 it had reached Saturn's orbit; and early this year it swept within the orbit of Jupiter.

On the first of June this year it was five hundred million miles distant from us, but rushing in at an ever-increasing speed. In June its velocity of approach was a million miles a day.

It will come nearest to our earth the first week of June, 1910, being then only twenty million miles distant from us—a hand-breadth in astronomical reckoning.

After this date it will move swiftly away from the earth, becoming daily more faint, till in the early days of 1911 it will disappear into the night, not to emerge again till the year 1985, when the most of those who read this article will have ceased to care about comets.

No small emulation is being witnessed between those observatories endowed with large telescopes, as to which one will be the first to pick up the returning voyager from far-distant shores. It is expected that this will be done in August or September of this year. The comet will then be a faint, nebulous star not far from Orion. But with regard to this matter of search, it may be said that it has already begun, chiefly by means of photography; it being thought that this auxiliary to science might make visible fainter objects than the eye can see.

In July of this year the comet held its course in the morning constellations, and was then badly placed for northern observers. It is so well placed, however, for southern observers that there is a hope that some observatory south of the line may have the good fortune to pick up the comet before the lengthening nights will enable northern observatories, armed with huge telescopes, readily to pick it up in the northern autumn. From September, 1909, to March, 1910, the comet will be well situated for observers all over the world, being then high up in the midnight sky.

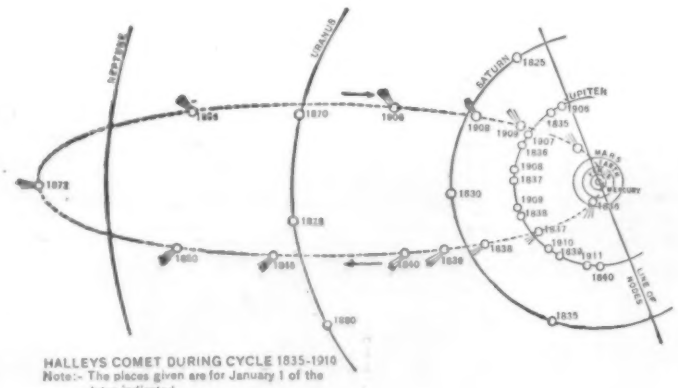
By the month of April, 1910, it will have passed right round to the evening sky, and toward the end of the month it will be lost in the rays of the sun. During May it is, for a brief time, a morning star; but in June it has again stolen round to the west, and should, in that month, be an object of conspicuous brightness in the evening sky of southern latitudes. It will remain an evening star till October of that year, when once more it will pass behind the sun, and then will appear as a morning star. By this time, however, it will be rapidly decreasing in brightness and will soon be lost to view.

There are few more interesting chapters in the history of astronomical research than that which tells the tale of the tracing back through the long centuries of this remarkable comet. Chiefly through the devoted labors of a group of classical and Oriental scholars, we can trace back the appearances of Halley's comet through twenty centuries, surely a long enough period to give it a distinction among comets.

Some of these appearances are of unique interest. On the Bayeux tapestry there is a famous picture of the comet which appeared in 1066 and which William the Conqueror regarded as a herald of victory for his arms. Hind proved that this fateful star was none other than Halley's comet.

Then, again, there are many references in classical literature to the appearance of various "fearful stars," some of which can be claimed as returns of Halley's comet.

It is a marvel that the deductive minds of many of the ancient philosophers did not see a connection



HALLEYS COMET DURING CYCLE 1835-1910
Note:- The places given are for January 1 of the dates indicated.

—as they did in eclipses—between regularly recurring phenomena. Possibly the fear which these supposed messengers of doom raised in the hearts of all, learned or unlearned, may have led the ancients to leave comets alone.

It is to Edmund Halley, the contemporary and friend of Newton, that we are indebted for lifting comets from the region of superstition to the calmer sphere of pure geometry. At Newton's request he undertook a thorough investigation of their movements, and into the laws which controlled these movements. The 1682 comet especially held his attention. His keen mind soon traced a connection between similar appearances separated by seventy-six years, and on working out the orbit of the comet, which will now forever be inseparably connected with his name, he boldly declared that it would again appear in 1758. It was seen for the first time on December 25th of that year by an amateur astronomer in Saxony.

Thus for ever the mystery which had gathered round comets was dispelled.

There are one or two very interesting questions connected with the return of this comet. Of these one is the constitution of these bodies. The usually accepted view is that they are composed of myriads of meteors at a very high temperature. But this does not explain their appearance thoroughly. It is indeed rather an imperfect explanation of the tail.

Then, do comets grow fainter each return? The belief prevails that they do. A comparison of the forthcoming appearance of Halley's comet in 1910 with the magnificent drawings made by Sir John Herschel of the 1835 appearance should do much to settle this question.

It is said that there are planets exterior to Neptune. Dr. See, of Mare Island Observatory, has even given them a local habitation and a name. If there are extra-Neptunian planets, then they should make their presence felt by perturbations of such comets as pass out beyond the orbit of Neptune. We have already referred to the near approach of Jupiter to Halley's comet in 1838. This approach would have the effect of pulling the comet back in its orbit, and thus by decreasing its centrifugal force bring it back more quickly again to the sun. Every planet circling round the sun tugs at the comet more or less, now hastening, now retarding its journey. Because of such "interferences" its path round the sun is a sinuous curve; and sometimes because of hindrances by the way, it takes seventy-seven years to return, while at other times it is incontinently pushed onward and its round is seventy-five years.

Thus if there are planets beyond Neptune they will make their presence felt in disturbing the comet as it passes its aphelion goal.

Enough has been said to indicate how much interest attaches to the appearance of this comet in 1910, and how eagerly its coming is being watched and waited for.

Status of the Birkeland-Eyde Nitrogen Reducing System.

It may be of interest to present some of the leading points regarding the present state of the nitrate industry in Norway, using the Birkeland and Eyde electric arc furnace. In this process, the gases coming from the furnace are rapidly cooled so as to prevent a decomposition due to the heat. In this way the yield is increased. Since 1905, when the first plant was started at Nottoden, Mr. Birkeland has been making researches with a new tubular furnace. On the other hand, the Baden Aniline and Soda Works, of Ludwigshafen, which is associated with the Norwegian enterprise, is also studying a new type of tubular arc furnace, but without the use of a magnetic field for blowing the arc. It appears to give satisfaction, and will soon be used experimentally in Norway. The question of fixing the nitrous vapors industrially has given rise to many researches. At Nottoden, the processes are kept secret as much as possible, however. The gas coming from the furnace is taken to oxidizing towers, where they remain for a certain time, and in this part the nitric oxide is finally transformed to nitrogen peroxide. The latter is passed into large granite towers of 35 square yards section and 60 feet height, and the gas is acted upon by a water spray. Nitric acid of 25 per cent strength is thus formed, and this can be used for preparing the nitrate of lime, which is used as a fertilizer. There remains 20 per cent of nitrogen peroxide in the gas coming from the towers, and it is passed into wood towers resembling the former and is there acted upon by the alkaline solution such as carbonate of soda or lime water. After this treatment the gases do not contain more than 3 to 5 per cent of the peroxide. The preceding products allow of obtaining nitrate of lime by neutralizing the nitric acid by roughly broken limestone, and the bath is evaporated by the waste heat of the furnace. The nitrate of lime for chemical purposes is delivered in blocks, while for agricultural purposes it is crushed and sifted. On the other hand, the treatment in the towers by the carbonate of soda solution yields nitrite and nitrate of soda. The pure nitric acid coming from nitrogen in this way gives rise to products which are of value for pyrotechnics, as it is found that the impurities in the industrial products often cause changes in the material and these give rise to accidents. The present acid is almost entirely pure and so is well adapted for this purpose. As to the value of Norwegian nitrate for fertilizing, H. De Felitzen finds that for oats the yield per acre is greatly increased. Without fertilizer we have the figure 4.2; with natural Chile nitrate it is 6.1, and with Norway nitrate it reaches 7.1. It is probable that 200,000 tons of Norway nitrate will be produced in 1913 and 125,000 tons in 1911.

Grinding Cement.

Fineness of grain is greatly to be desired, both in finished cement and in the raw materials of which it is made. In the new Pfeiffer cement machine the process of grinding is kept separate from the expulsion of the meal, or product of grinding. The last-named operation is effected by means of a fanning mill of peculiar construction which, without employing any sieves, delivers a product of very fine grain. The machine requires much less power than the ordinary machine, so that a very fine cement can be produced more cheaply than common cement is produced by the usual methods.

It is gratifying to learn that the application of block signaling on the railways of the United States is increasing, although not very rapidly. The last report of the Interstate Commerce Commission shows that the total length of road operated under the block system at the beginning of the year was 59,548 miles, a net increase over the previous year of 879. The small increase is attributed to the financial depression.

THE WIESEN VIADUCT.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A piece of railroad construction in Switzerland which presents considerable interest is the great Wiesen viaduct, which has been building for some time past. The viaduct's central span is one of the longest as well as the highest to be found in the country.

The present viaduct forms part of a new section of railroad of short length which has been undertaken within a recent period in the region lying in the eastern part of the country. The line belongs to an extensive system of railroads known as the Rhätische Bahn, and it is designed to give a long-needed passage through the picturesque Davos-Landwasser valley, for up to the present the valley has been traversed only by an ordinary road. Hereafter the well-known mountain resort of Davos will have a direct connection with the region lying to the south. The line thus gives an outlet to the center of the Graubunden canton, and passengers can easily reach the different parts of the Engadine region by rail. The new railroad section will thus be a great advantage for Davos, so that the resort, which is already much frequented, will have a still greater development after the railroad line is finished. Connection is now made with the Abula railroad, which is another of the Swiss lines recently built in this region.

Work on the construction of the new line, known as the Davos-Filisur route, is actively under way at the present time. The railroad is of short length, like many of the mountain lines in Switzerland, for it is scarcely over 11 miles long. Still it presents many interesting features. A gage of 1 meter (39.37 inches) is employed in this case. Davos, the starting point of the line, lies at an altitude of 5,019 feet above sea level, while the southern terminal at the locality of Filisur has an altitude of 3,521 feet, so that the gradients on the section are considerable. The maximum gradient is 35 per cent and the minimum radius of the curves 380 feet. The track is laid upon steel ties. Following along the valley of the Landwasser, which after Schmelzboden narrows to a deep gorge lying between high rock walls, the route is one which tourists will find agreeable for its picturesque character. On the section between the above locality and Wiesen a considerable amount of work has been done in the way of tunneling and building viaducts. In all, there are six tunnels, the longest of which is the Silberberg tunnel. In its construction springs were met with which gave some difficulty. After crossing the mountain torrent of Monatstein, the line reaches the locality of Wiesen, near which is situated the great viaduct, lying between Wiesen and Filisur. The main central span lying over the Landwasser stream is 182 feet, and the height of the arch above the level of the stream is about 300 feet. It was difficult to obtain suitable building stone in the region. Concrete was used for the main body of the work, and hewn granite for the facing. At the top of the arch the width is 126 feet, and at the base the width is 165 feet. The thickness at the summit is 6.0 feet and at the bottom 10 feet for the masonry. On each side of the main arch there are two arches of smaller size, having 65-foot span and lying at the same height above the level of the stream. In order to carry out the work of building the principal arch there was thrown across the stream between abutments an iron trelliswork bridge of 3 feet width, which was held upon two suspension cables, these latter being anchored at either end. The viaduct is built according to the designs of M. Hans Studer, one of the leading engineers of the road.

The Current Supplement.

Thanks to the speed of modern steamers and the development of the railroad system in India, the base of the Himalayas is now only twenty days' journey from Mediterranean ports. Hence, mountain climbers who wish to distinguish themselves by lofty ascents or explorations have undertaken summer expeditions in the high mountains in northern India. In the first rank of these explorers stand Dr. and Mrs. Bullock Workman, who since 1898 have made five expeditions in the Himalayas. Their latest exploits are recounted in the opening article of the current SUPPLEMENT, No. 1754. D. Geyer contributes much curious information in an article entitled "Snail Gardens." Dr. Reiner Mueller writes on the subject of the inheritance of acquired characters in bacteria, and shows how it is possible by artificial means to impress upon a living organism a new and definite character, which is hereditary and which remains constant through a vast and indefinite number of generations. An approximately correct idea of the form of our planet is a comparatively recent acquisition of science. Dr. Givet of the French Equatorial Geodetic Expedition tells us how this new knowledge is obtained. The yeast cell and its lessons are taken as the subject of an instructive article by W. Stanley Smith. The oxhydric process of cutting metal is a new technical achievement painstakingly discussed by E. F. Lake. Maria Parloa's excellent monograph on the canning and preserving of fruit is continued. Twenty-five years have elapsed since Arrhenius advanced the theory that acids, bases, and salts in aqueous solution are dissociated into their constituent ions. Now that the storm of contention aroused by this doctrine is clearing, it may not be inappropriate to consider more calmly this proposition of Arrhenius's, to reinspect the foundations, and to weigh without prejudice the successes and the failures of the ionic theory. This has been done by Gilbert Newton Lewis in a thoughtful article entitled "The Use and Abuse of the Ionic Theory." The Engineering, Electrical, and Trade Notes will also be found as usual.

The Glidden Tour.

The sixth annual tour of the American Automobile Association, better known as the Glidden Tour, was completed at Kansas City, Mo., on the last of July after a more than usually strenuous journey of fifteen running days from Detroit *via* Chicago to Denver and back to Kansas City.

It is impossible for us with the space at our disposal to give even an outline of the performances of the various cars or the incidents of the trip; but as at least half the space in a number of automobile trade journals have been devoted to such details for three successive weeks, it is perhaps hardly necessary.

There are, however, several features of the tour worthy of especial mention, even in a non-specialist paper.

The roads are agreed by a number of veteran Glidden tourists to have been the worst ever encountered, varying from axle-deep sand to mud as deep, and, perhaps worst, axle-deep ruts in hard-baked "gumbo." In several cases the entire crew of a car was thrown out by crossing too swiftly in descending a hill, a concealed water bar, or similar obstruction; grass hummocks and even bowlders grazed axles and under pans, and bridges on the prairie roads had to be repaired before safe for passage. Considering these difficulties, the fact that 8 cars finished with perfect road scores (without losing marks for delay, breakage, repairs, or adjustment *en route*), as many as 21 out of the 32 contesting cars covering the first 830 miles to Minneapolis over perhaps the worst roads encountered without being penalized, is strong testimony in favor of the claim that the reliability of American manufacture has reached something like perfection. Even the expected spring troubles were conspicuously few.

Whereas in former years the Glidden has been considered to be a "big car" tour, small cars having hardly a fair chance to make a showing proportionate to their cost, an attempt was made this year in the system of marking and distribution of the trophies to place the smaller cars on equal terms. The result, however, still shows that the best low-powered car is hardly equal to so strenuous a journey.

Great hospitality was shown to the tourists at practically every town and village passed, Detroit, Minneapolis, and Denver particularly distinguishing themselves, and farmers' families lining the route even in remote districts. The latter seem to be overcoming their hostility to horseless vehicles, not merely making way for the automobile and taking its dust with a better grace, but themselves adopting its use to avoid those alternatives. The interest shown by the agriculturist in the tour should benefit participants in the latter commercially in these days of high-priced grain and promise of abundant crops, as well as materially assisting the universally beneficent cause of good roads.

The Glidden trophy for the largest cars and the Hower trophy for runabouts were won by "Pierce Arrow" cars, three of which finished with perfect road scores, the two winners actually having no marks deducted for any re-adjustments to be made at the finish to put them in the perfect condition in which they started, which is certainly a most remarkable showing.

The Detroit prize for intermediate cars was won by a "Chalmers-Detroit" car; two of the three "Premier" cars entered also finished with perfect scores.

A remarkable record was made by a "Rapid" commercial delivery truck, which was sent on the unaccustomed 2,600-mile journey by its enterprising manufacturers, carrying over a ton of baggage and accessories for the tourists on solid tires. It not only rendered yeoman service, but actually would have been unpenalized on several of the worst days' runs had it been competing with the touring cars, and climbed Pike's Peak as a diversion during a pause in the tour.

BLERIOT'S CHANNEL FLIGHT AND OTHER RECORDS IN FRANCE.

We reproduce herewith several photographs showing the start of Blériot across the English Channel, and also showing him flying above the Channel when beyond sight of land. These photographs give an excellent idea of the birdlike appearance of Blériot's monoplane when in flight. A full description of his record flight and of other records which he has made appeared in our last issue.

The extremely rapid progress being made in aviation in France is truly astounding. One of the men who has made extraordinary progress is M. Roger Sommer. His record to date is truly remarkable, and shows that when one once learns to fly an aeroplane, there is a fascination even greater than that experienced with the automobile. During six consecutive days, from July 13th to 18th inclusive, M. Sommer made the following flights: July 13th, two flights of 15 and 19 minutes. On the 14th, a flight of 27 minutes at a height of from 30 to 65 feet, covering a distance of 12 kilometers (7.5 miles) outside the limits of the aerodrome within 10 minutes. On July 17th, a 30-minute flight, during which 12 liters (3.2 gallons) of gasoline were consumed; and on the 18th a flight of 1 hour and 4 minutes. On July 27th this time was increased to 1 hour, 23 minutes, and 30 seconds. On August 1st he flew 1 hour, 50 minutes, and 30 seconds, beating all French records. Three days later he made a flight of 2 hours and 10 seconds, which, up to the time of our going to press, is the longest record made by a foreign aviator. M. Gaudart is another beginner who has recently met with considerable success. On July 18th at Juvisy he made three circuits of the aerodrome in a gusty wind, covering a distance of about 4½ kilometers (2.5 miles). Starting at 3:14 A. M. on August 7th, in the moonlight, he made a flight lasting 2 hours, 27 minutes, and 15 seconds, the altitude attained varying from 20 to 90 feet. This surpasses the record of 2 hours and 20 minutes made on December 31st last by Wilbur Wright, and is an endurance record for an aeroplane.

Capt. Ferber made several flights on the Champ de Mars on July 18th with his Voisin biplane. Two days later he made six successful flights at Belfort, after which he shipped his machine to Vichy for the aviation meet. On July 19th Henry Farman made a flight of 1 hour and 23 minutes at Chalons. The flight started at 8:17 P. M. and terminated at 9:40, when the gathering darkness obliged Farman to descend. His new machine has the tail placed farther apart than the former one, and is fitted with runners instead of wheels. The balancing planes are placed between the ends of the main plane. On July 21st at Chalons Mr. Farman took up Mr. Cockburn in a new machine which the latter has just purchased. It made a circuit of the camp, a distance of about 1½ miles.

From the above it will be seen that the aeroplane is making great strides in France. No less than forty-six machines have been entered for the great aviation meeting at Rheims during the week beginning August 22nd, and at this meeting aviation abroad will for the first time be put on a sound footing.

COMPLETION OF THE GOVERNMENT CONTRACT BY ORVILLE WRIGHT AT FORT MYER.

With the making of the ten-mile cross-country speed test by Orville Wright at Fort Myer on July 30th, as mentioned in our last issue, the government requirements for a heavier-than-air flying machine were completely fulfilled. The speed averaged by the machine carrying Orville Wright and Lieut. Foulois as passenger, according to the timing of the officers in charge of the test, was 42.58 miles an hour. On the outward journey, when flying somewhat against the wind, the machine averaged 37.735 miles an hour, while on the return trip the average speed was 47.431 miles an hour. As the bonus offered by the government was $2,500 for each mile per hour in excess of forty, without taking into consideration fractions of a mile, the Wright brothers received a bonus of $5,000, which made a total of $30,000 for their machine.

The more one considers this remarkable flight, the more the excellent qualities of the Wright biplane and the daring of Orville Wright in making the cross-country flight to Alexandria, Va., stand out. With a somewhat smaller machine than that used last year (the planes are 36 feet long by 6 feet from front to rear) some 1,200 pounds of weight was carried at a speed of 42½ miles an hour with an expenditure of not over 30 horse-power. This means that the machine lifted 40 pounds or more per horse-power expended, and carried this weight at a faster speed than has ever been shown in an official test by any other aeroplane. The weight lifted per square foot of supporting surface, however, was much less than in the case of Blériot with his No. XII. monoplane, for the Wright machine carried only about 2½ pounds to the square foot, whereas Blériot lifted over 5. The speed the latter attained in an official test at Douai, France, last month was 10 miles per hour less than that reached by the Wright biplane in its test at Fort Myer, although Blériot's monoplane had approximately the same horse-power and lifted practically the same weight. A comparison of the two machines shows very neatly, therefore, the greater lifting power of a single deeply curved surface over superposed slightly curved surfaces, and brings out

the fact that when such a surface is used, as was the case with the Bleriot machine, speed is sacrificed for lifting power. On the other hand, however, as a practical machine for the use of sportsmen, the monoplane of Bleriot offers distinct advantages in the way of small space occupied, light weight of the apparatus, and ready portability. After making his 25-mile cross-country flight from Etampes to Chevilly on July 13th last, Bleriot dismounted the wings of his machine, fastened them to the sides of the body frame, and towed the machine over the road on its three wheels to Paris, a distance of 61 miles, arriving there by evening. The performance of such a feat shows the superior adaptability, for war purposes and for all practical uses, of the monoplane type of aeroplane mounted on wheels as compared with the biplane type of machine mounted upon runners and requiring a starting rail and dropping weight to launch it.

The fulfillment of the specifications of the United States government for a heavier-than-air flying machine marks an era in the development of aerial navigation. When these specifications were issued in December, 1907, the Wrights had not demonstrated any of their claims, the chief of which was that they had flown for 38 minutes more than two years before. Santos Dumont, Farman, and Delagrange had made little more than jumps, and the art of aviation was in its infancy as far as any practical demonstration of what had already been done by the leaders was concerned. The specifications issued by the War Department required an endurance flight of one hour with a passenger; a cross-country speed test with a passenger for a distance of ten miles, in which a speed of not less than 38 miles an hour must be shown; and the carrying of sufficient fuel for a 125-mile (3-hour) flight. These specifications were so rigorous, that even the most hopeful aviators were doubtful whether they could be fulfilled; but when Wilbur Wright flew for 2 hours and 20 minutes on December 31st last in France, all doubt was dispelled as to whether or not the Wright brothers could fulfill the specifications. Nevertheless, the best speed shown by the Wright machine in France in the different speed tests there did not exceed 38 miles an hour very much, and there was consequently considerable doubt as to how fast the machine could travel, and how much bonus Orville Wright would win. After making the hazardous trip over several deep valleys and high hills, he expressed his belief that had there been no wind to drive him out of his course he would have made 44 miles an hour and received the full bonus. The height which he attained in passing over the valleys was 400 to 500 feet. When the fact is considered that had the motor stopped, both men in the aeroplane would have been in imminent danger of losing their lives from the descent of the machine on the tree tops, one can readily see that the making of this flight required more daring than the making of a flight across the English Channel. Not only this, but two lives were in jeopardy all the time.

A glimpse of Bleriot shortly after his start.

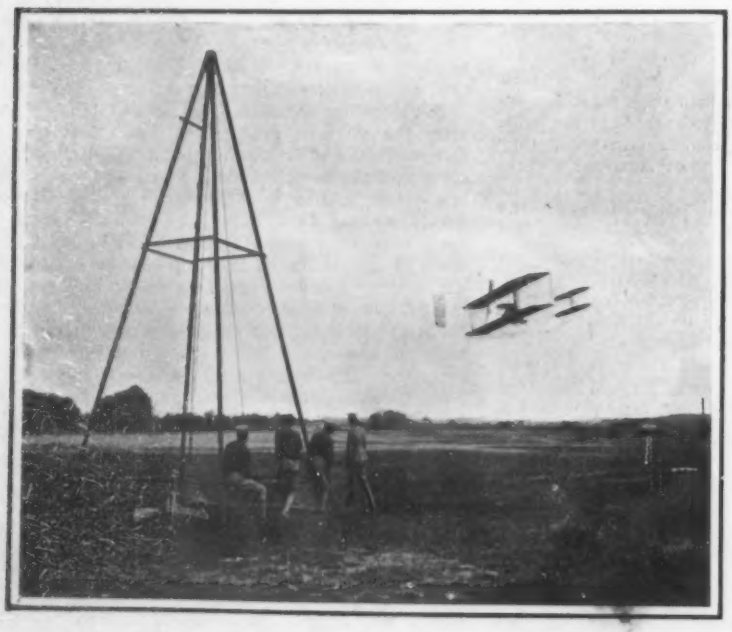
Bleriot in mid-Channel.

BLERIOT'S FLIGHT ACROSS THE ENGLISH CHANNEL.

There are several new aviators in France who almost daily are making new records. Chief among these is M. Paulhan, who, with his Voisin biplane fitted with a tail and a Gnome revolving cylinder motor, on July 19th made a cross-country flight from Douai to Arras, a distance of 13 miles. The flight was made in 22 minutes, at an average speed of 35.4 miles an hour. Next to Bleriot, M. Paulhan holds the record for cross-country flying in France. He also holds the record for height, having flown to a height of 120 meters (393.8 feet), and thereby beaten Wilbur Wright's 110-meter (350-foot) record made on December 18th last at Auvours. Some of M. Paulhan's recent records made at Douai are as follows: 12 kilometers (7½ miles) in about 15 minutes at a height of 30 meters (98 feet); July 23rd, 1 hour 17 minutes 19 seconds, covering an official measured distance of 48.178 kilometers (30 miles), but actually traversing a distance of 70 kilometers (43.5 miles), when the wide turns are considered.

July 18th, M. Paulhan raced M. Bleriot with the latter's biplane at Douai, over a distance of a kilometer (0.621 mile) in a semi-circle. This was the first time two aeroplanes have engaged in a race, and the fact that these were a biplane and a monoplane with two distinctly different types of motors made this race all the more interesting. M. Bleriot won in the time of 1:09, an average speed of 32.4 miles an hour, while Paulhan's time was 1:37, an average speed of 23 miles an hour. The same day M. Bleriot won the Prix du Nord by covering 2 kilometers (1.4 miles) in 2 minutes 29 seconds.

Although America was the first to secure an aeroplane for the use of its War Department, several other nations are quietly working to develop machines of their own. In England, Capt. Cody, who however has not been aided very much by the government, has lately been making successful flights with a biplane nearly twice the size of Wrights'. On July 21st he flew 4 miles above Laffan's Plain near Aldershot. This is the first biplane, according to Capt. Cody, in which every possible effort has been made to avoid head resistance. He believes that his machine has less head resistance than any other so far constructed of the same size, and with an engine of about 30 horse-power he has flown successfully at good speed. The French government also is experimenting with a biplane, but up to the present no attempt has been made to purchase such a machine from any of the numerous constructors. Orville Wright expects to go to Germany very soon, with the idea of selling a number of machines to the German government. Italy has already acquired one Wright aeroplane, and will probably have several more soon. The Austrian and the Russian governments are also interested in aeroplanes for war purposes. Up to the present time, however, our country and Italy are the only ones which have aeroplanes, and which are ready to purchase more of these machines in the near future. It is probable that new specifications in which greater requirements will be made will be issued within a short time by our War Department.



A short turn.

The Wright machine in a sunset flight.

THE LAST WRIGHT FLIGHTS AT WASHINGTON.

AN AMERICAN FORESTRY SCHOOL.

BY DAY ALLEN WILLEY.

One of the Eastern States to which forestry is of really vital importance is Pennsylvania, for the reason that such a large revenue has been secured from its timber interests. Only ten million acres of its area has thus far been devoted to agriculture, the lumbering industry being very extensive over the balance of the State on account of the forest growth. In Pennsylvania, as well as other States, the lumber industry has been accompanied with great waste owing to the crude methods employed—the large quantity of valuable stumpage being left, young trees broken down in felling larger ones, while the practice of "skinning" the forests or cutting down the most valuable trees regardless of the destruction to the young growth has in itself caused a great loss.

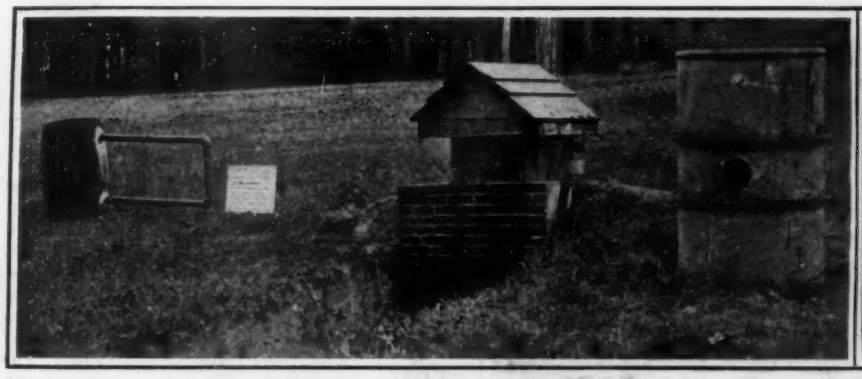
Several large railroad companies obtain much of their timber from the State, especially the Pennsylvania Railroad Company, which has introduced a forestry system on its own lands that has resulted in much practical benefit. The most notable movement, however, is one which has been taken up by the State authorities in the creation of the only undergraduate forest school between Michigan and Maine. The school has been planned on a very broad scale and is intended not only to educate those who attend it in every branch of forestry but to conserve this most important resource so that the timber supply of the State will be permanent.

The institution itself is located in Center County, where an excellent opportunity is provided for a study of the various branches, but in addition the students are sent to various portions of the State as well as out of Pennsylvania for additional study and practice. The State College, as it is termed, gives special attention to field work in addition to the routine of the class room and lecture room. In connection with the earlier courses in forestry the men are taken into the field, where they study each kind of tree, its form, its bark, leaves, buds, and flowers, until they are perfectly familiar with the trees and the material with which they will work. Following this they carry on during the fall season the work of collecting the fruit and seeds of various trees and their storage, dry in bags or buried in moist sand. In the spring the seeds are taken and planted in forest nurseries, the students doing the actual work of planting and cultivation. Numerous trips are made in the vicinity of the college to study natural reproduction of the forest. Near by is a State reserve of several thousand acres and the State Forestry Reservation Commission has given the college an annual privilege of going upon this reserve for study and demonstration in forestry. There is no other forest school in the country that has so large a tract of wild land so near at hand and so available for study at all times. Last year one of the advanced classes made a topographical sketch of a large gap in the hills which supplied the college with water, and followed this with a forest map, showing the nature and amount of timber growth, and from notes taken in the field worked out a plan for the future management of the watershed.

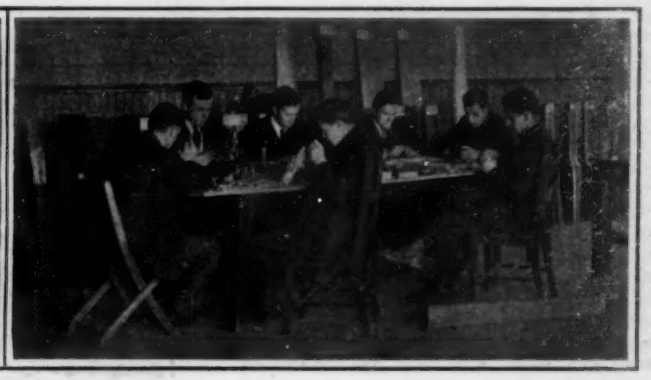
At the State College the course of training includes not only preparation for forestry in the East but forestry in the West. As an illustration, the students are even instructed in the use of pack animals, which are so much depended upon in the great national forests, where the only route may be a pony trail. The course of instruction includes the care and use of ponies and mules, the methods of loading them, also riding. Pack trains are fitted out and the students make expeditions as they would in the Rocky Mountain region or on the Pacific coast. Two weeks at the end of the junior year are spent in camping upon some large wood lot in the State, where the boys get very practical training in camp life; in the estimating of timber and its actual measurement by various methods; rapid sketching and mapping of forest areas and in study of tree growth by analysis of tree trunks. From the data obtained in the field a map is made and a plan drawn up for the correct management of the wood lot. There are many locations in Pennsylvania which are admirable for field work because within a small area may be a large number of varieties of trees forming a miscellaneous growth. An opportunity is also given the students to investigate the different varieties of soil, the extent of the watershed, and to obtain other data which

Students learning packing of animals for mountain transportation under chief packmaster, U. S. Army.

Work with transverse plane table in rapid measurement and sketching of forest types and areas.

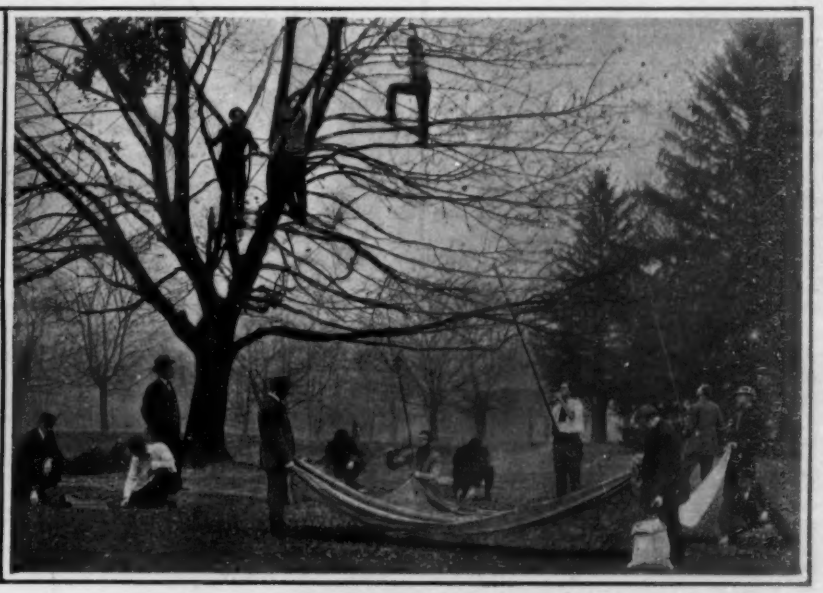


Small plants used for teaching principles of treatment of timber with creosote.



Forestry students studying structure of commercial timbers and methods of identification.

Operations on sample trees in wood-lot to determine average rate of growth for every decade.



A class in silviculture gathering seed of maples in a large sheet.

will be of great value in connection with their future vocation.

During the last year the members of the graduating class are put through a very rigid test, being required to spend at least four weeks in some forest region either in Pennsylvania or other States. They are sent to a lumber camp where they make a study of lumbering as associated with forestry. This month in the lumber woods is taken as a part of a course in lumbering in which each operation from the log in the tree to the finished product is thoroughly discussed. The men are provided with an outline to aid them in their studies and will prepare a complete report on the lumbering operation which they investigate. They are also placed during the summer vacations where they will get the most practical experience in forestry.

To get the men in touch with practical forestry as it is being carried on by private individuals through the State and in its various forest nurseries, as well as the work of manufacturing companies who put out tools and equipment used by the forester, one or more trips are made each year by the juniors and seniors, and it is planned to increase in so far as possible the usefulness of these trips. The students have visited various plantings of locust made by the Pennsylvania Railroad along its lines between Harrisburg and Philadelphia. In these plantations they studied the injury done by the locust borer and by mice and have learned that the locust was not a tree of value for general planting throughout the State. At Pottsville, the forestry work carried on over the Stephen Girard estate has been carefully studied. On this estate extensive planting has been done, but without the best results, because of injury from fire. Stone walls have been built and fire lanes or roads established which are as good an example of this method of preventing fire as can be found in the country. The advanced students have made trips through the southeastern portion of the State, visiting the large forest nursery of the Pennsylvania Railroad at Morrisville, which has been established by the Pennsylvania Railroad. This is reported to be the finest forest nursery in the United States. It had a million and a half of red oak seedlings grown from acorns which were set out in the spring of 1909. Industries associated with forestry, such as works showing the way in which wire rope and cable are used in logging operations, have been visited and where the students were able to see the making of all classes of saws from the crude material to the finished product.

This brief outline gives an idea of the broad and comprehensive scope of the instruction as carried out at this institution, but the opportunities for the graduates are such that the school authorities consider the work well worth while. There is such a constantly increasing demand for the trained foresters that it is much greater than the number who now graduate, while the salaries offered make it an inducement to a young man to take it up. The college continually has requests from large lumber companies throughout the country for graduates and sometimes under-graduates. The United States Forest Service is also another source of employment and this institution has already sent quite a large number into the national forests in Montana and other States. In fact the demand for graduates is assuming such proportions that expert forestry will undoubtedly become a vocation which will give many thousands employment, and the results at the Pennsylvania institution prove that similar schools established in other parts of the country will be of far-reaching benefit in solving the problem of conserving the national woodlands.

At the head of the State College is Dr. Hugh P. Baker, a graduate of the Yale Forest School, who was also connected for several years with the United States Forest Service. The State authorities have provided Dr. Baker with a staff of experts so that, as already noted, not only instruction but field work has been provided in literally every detail which concerns this subject.

In Pennsylvania forestry is taken up in connection with the work of the agricultural and mechanical departments of the State University, as it is believed this is the best method. As forestry is a production of a crop from the soil, in a sense it is agriculture, and because the utilization of the crop demands considerable knowledge of engineering, the instructors are able to give the students work in the departments of civil, mechanical, and mining engineering—just the kind of employment that they need. Consequently the work is closely connected with the vocation of the farmer, and the one who completes the course of study with the view of becoming an agriculturist is in a position to get the most and best of his woodland and to make it a permanent resource.

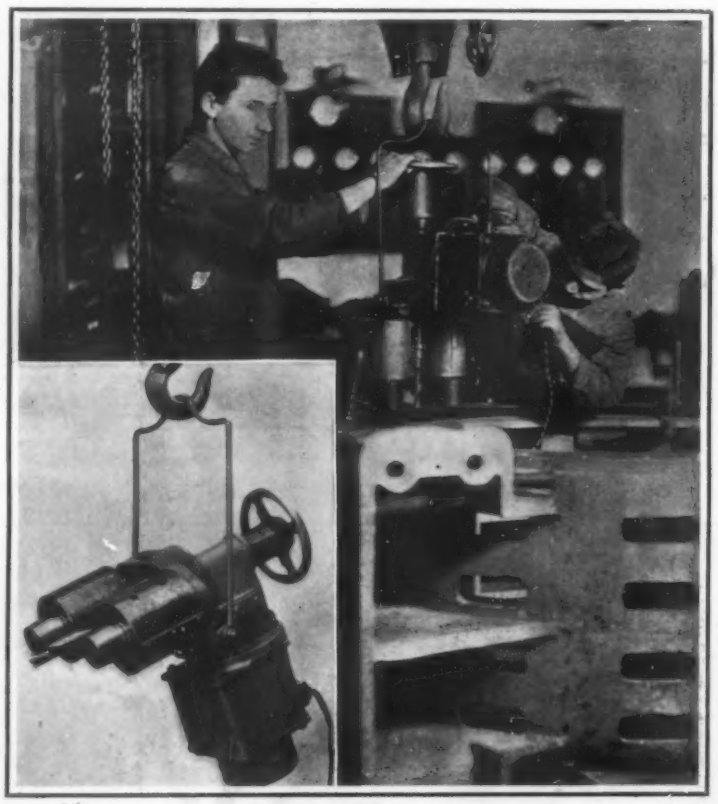
It may be added that the length of this course is four years, the first two years of which are devoted largely to foundation principles, which are absolutely necessary to the proper training of the forester. Beginning with the third year they take the men and give them two solid years of training along forestry and closely related lines. In connection with the actual forestry work the students take such subjects as fish and game preservation, diseases of trees, roads and trails, elementary irrigation engineering, elements of mining, in which they are taught in an elementary way the mining of various minerals, the timbering of mines and the laying out of mining claims. The students are also given a practical course in timber testing in their mechanical engineering department.

AN ELECTROMAGNETIC DRILL.

BY THE GERMAN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A very efficient electromagnetic drill has recently been designed by the German engineer Burckhardt. This machine is intended for use in all branches of the iron industry, e. g., in boiler shops, ship yards, erecting shops, and the like.

The ingenious combination of an electrical motor with an electromagnet adapts this machine to all



A NEW ELECTROMAGNETIC DRILL.

boring, milling, countersinking, and broaching. Electromagnets placed on both sides of the drill spindle throw the machine so tightly against the work as to allow any one of the operations mentioned to be carried out rapidly.

A special attachment on the drill spindle allows the tool to be rapidly and accurately centered on any given point of the working surface. The machine is thus adjusted within a few seconds.

As represented in the accompanying figures, the drilling machine is suitably suspended for this purpose. On horizontal surfaces the drill can obviously be used without any suspension. A special device is used in upward drilling.

The electromagnetic drill comprises four main parts, viz., the driving motor, the drill proper with its centering device, the electromagnets, and the suspension.

The motor armature drives the drill shaft through a normal toothed-wheel gearing. The shaft can be axially displaced with a view rapidly to adjust the drill point on the center mark. The balanced suspension device can be used for the same purpose.

The electromagnets are placed on a yoke, pivoted in the plate extension of the machine, and fixed with a nut. The magnet yoke, with its two coils, can accordingly be adjusted to any desired angle. A clamp screw is used to hold it in position.

The pole pieces fitted to the ends of the magnet coils are interchangeable, their length and shape being adapted to the tool in actual use, as well as to the form of the working surface. The pole pieces must be held as tightly as possible against the tool with their entire surface. The suspension device should be fixed at such height above the working floor as to allow the drill to be rapidly conveyed to any point of the shop. The tool is preferably a spiral drill of hard tool steel.

By employing pole pieces of different heights, drills of different lengths can be used.

The Psychology of Reading.

Examinations made by Erdmann and Dodge may serve as a foundation for the psychology of reading, and through careful experimental observation these scientists have reached results of extraordinary interest.

Hitherto two views have prevailed, the one being that reading was effected solely by spelling, each letter therefore being grasped and perceived for and by itself; the other being that the words were grasped not exclusively letter by letter but in small groups of letters in the same spaces of time.

We learn from their report in the Zeitschrift fuer Psychologie und Physiologie der Sinnesorgane that Erdmann and Dodge first ascertained through reflection of the left eye, while the head was kept in a steady position, that in reading an easily comprehensible text there is a regular change between pauses of rest for the eye and its movements. The number of these pauses, however, is much smaller than the number of the letters over which the eye glides, and it remains, in the case of the same person, almost unchanged as long as a fluent text is used. If the text becomes more difficult in the meantime the number of pauses is increased a little, and where attention is given exclusively to the formation of words, as in "proofs," the number becomes three times as large.

So much having been ascertained, the next object was to ascertain whether reading was effected during the pauses of rest or whether the letters presented themselves with sufficient distinctness while the eye was moving to the right. Through perfectly exact observation and calculation both investigators came to the conclusion that reading was effected exclusively during the pauses of rest. On an average the eye glides, during a definite movement on the line, over a space of 1.52 to 2.08 centimeters, a space that contains about twelve to thirteen letters. The rapid change of the black and light textual elements—the letters and the interstices—makes it more impossible for the eye to recognize the letters while it is in motion. It was also ascertained that by a very brief exercise of vision, while the eye is still, four letters without exception, five at the most, can be recognized at the same time, even when they do not occur in a sequence of words. In the case of such a sequence, however, four or five times as many letters can be read during the same interval of vision. In the short pauses of rest while reading one recognizes the words solely from their optical collective form, if the letters are not too large, and such recognition is by so much easier as the words show themselves more characteristic and fluent to the reader. Even a beginner can therefore with a little practice enable himself to read not only without spelling but with a visual grasp of whole words at a time. How far this capability may reach depends on the optical memory of the reader.

Official Meteorological Summary, New York, N. Y., July, 1909.

Atmospheric pressure: Highest, 30.24; lowest, 29.46; mean, 29.93. Temperature: Highest, 92; date, 30th; lowest, 58; date, 4th; mean of warmest day, 84; date, 30th; coolest day, 66; date, 4th; mean of maximum for the month, 81.4; mean of minimum, 65.5; absolute mean, 73.4; normal, 74; deficiency compared with mean of 39 years, 0.6. Warmest mean temperature of July, 78 in 1901; coldest mean, 70 in 1884. Absolute maximum and minimum of July for 39 years, 99 and 50. Average daily excess since January 1st, 1.7. Precipitation: 1.98; greatest in 24 hours, 1.56; date, 23rd; average of July for 39 years, 4.32. Accumulated deficiency since January 1st, 2.15. Greatest precipitation, 9.63, in 1889; least, 1.18, in 1907. Wind: Prevailing direction, south; total movement, 7,922 miles; average hourly velocity, 10.6; maximum velocity, 46 miles per hour. Weather: Clear days, 13; partly cloudy, 13; cloudy, 5; on which 0.01 inch or more of precipitation occurred, 5. Thunderstorms: 16th, 18th, 30th. Coolest July in 12 years.

Handy Man's Workshop

HOW TO MAKE CONCRETE POTTERY.—V.

BY RALPH C. DAVISON.

(Continued from the issue of July 31st.)

After having mastered the processes of modeling and casting as explained in the previous articles, the craftsman can now take up the decorative features. The possibilities of ornamentation, one can say, are almost unlimited with this material. Various effects can be obtained. One can reproduce antiques which can hardly be told from the originals, and original designs embodying various colors can be made which will compare favorably with modern clay pottery effects. Owing to the material used the texture obtained is one which is full of life and sparkle. It has a distinct characteristic of its own which cannot be obtained in any other material.

As a specific case of what can be done along these lines we will take the copy of an antique which is illustrated herewith. This was made as follows: It was first cast with perfectly smooth sides, a mixture of one part Portland cement to two parts of fairly coarse brown sand being used. After pouring this mixture it was allowed to set in the mold for from eight to twelve hours. The mold was then removed and the piece was found to be in a more or less soft state. That is, it had to be handled carefully, and the concrete had not become so hard that an impression could not be made in it with the sharp point of a knife; the design as shown was then marked on the surface, and in turn it was cut and dug out by a strong knife blade. A straightedge was placed along the various lines, being used as a guide for the blade. The depth to which the design should be cut varies according to the size of the piece; but in small work usually from one-eighth of an inch to three-sixteenths of an inch will give the most effective results. If for any reason one cannot commence the work of cutting out the design within twelve hours after the piece has been cast, or until the piece has become quite hard, it will then be necessary to use a small hammer and chisel with which to cut out the design. Care should be taken, however, in using these tools not to strike too hard a blow, for if one hits too hard the piece may break, although in antique work if the edges of the cut-out design are more or less irregular it makes the piece so much more effective.

In preparing any article for color inlay work, which has been modeled and built up on wire forms as explained in numbers I and II of this series, such as a vase or other piece, the design must be cut out previous to the inlaying of the colors exactly as has been just described for antique relief work.

If, however, the piece to be inlaid is to be made in a mold as described in articles III and IV, the mold can be prepared to form the desired depression, in which case the design will be cast in the piece. For complicated designs of this character a clay model must be provided from which the plaster mold is made. But in simple designs such as illustrated the piece which is to form the recess can be attached to the inside of the outside mold as shown in Fig. 24. This can be made of wood and can be secured in place by brads. It should be located in the proper position and should be of the exact size and shape of the outline of the design and at least one-eighth of an inch thick. Shellac and oil the piece well before pouring the cement and allow a good bevel or draft on all of the edges so that it will draw out easily from the cast and thus leave a good, clean, sharp edge to the cavity into which to lay the colored cements.

A great many attempts have been made to produce satisfactory color work in cement, but until of late these attempts have been most unsatisfactory. This was largely due to the fact that ordinary Portland cement is of a gray color and on mixing it with the various color pigments the result was a decidedly dirty or dead tint of the color used, similar to that which would be produced in water colors by mixing them with water which had already been discolored by India ink or lampblack. Another cause of unsatisfactory results along these lines was the fact that many of those who experimented did not use the proper color pigments, the result being that the colors faded out on exposure to the weather. The first cause of not being able to produce true tints can now be overcome by the fact that a really true white Portland cement is being manufactured. This now can be procured from almost any cement dealer. By using

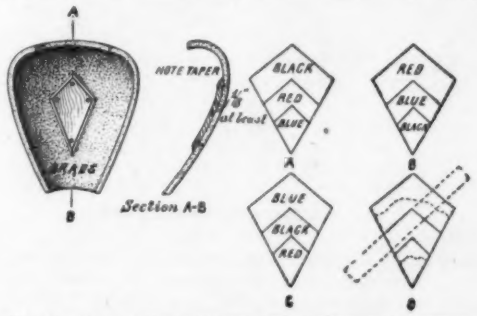


Fig. 24.—MOLD FOR FORMING THE RECESS AND STEPS IN LAYING THE COLORED CEMENTS.

this as a base with which to mix the pigments, true, clear colors can be obtained, and by the use of nothing but good mineral pigments, known as lime or cement-proof colors, it is possible to produce shades which will be absolutely permanent.

The writer has experimented largely with coloring matters from this country as well as from abroad. Many of the coloring matters obtained from abroad are very good, but their cost is naturally higher than those which are made in this country.

As before stated, mineral colors are those which give the best and most permanent results. They all come in powdered form and should be mixed with the dry cement and marble dust or white sand, as the case may be, until the whole mass is of a uniform tint throughout. After having mixed them as above, water should be added and the whole mixed into a mortar.

The following pigments, which can be procured from almost any of the large manufacturers or dealers in dry colors, will give satisfactory and permanent results:

Dry Pigments.	Resulting Color.
Red oxide of iron, Venetian red	Red
White Portland cement	White
Ultramarine blue, Oxide of cobalt	Blue
Chromate of lead, Yellow ocher	Yellow
Chrome oxide of copper	Green, light
Carbonate of copper	Green, dark
Lampblack, Torch black, Black oxide of copper	Black or Gray (according to quantity used)
Ordinary Portland cement	Gray
Burnt umber	Brown

The amount of coloring matter to use in proportion to the cement depends entirely upon the depth or shade of the color desired. By mixing up small specimens of the color with various proportions of cement and making small test pieces of mortar and then noting the color of these after they have dried out, one can readily determine the proper amount of coloring matter to use. It is always better to weigh the amount of pigment used rather than to judge the amount by bulk, for by weighing a much more uniform result can be obtained.

For ornamental work where a wide range of colors is desired they can be procured by the same means as is used in water or oil color painting; that is, by mixing together the three primary colors, which are red, yellow, and blue. From these three colors can be obtained every color or tone that may be required. Thus blue mixed with yellow produces green; blue mixed with red produces violet, and red mixed with yellow produces orange, etc. In combining the coloring matters, always do so while they are in a dry state and thoroughly mix or grind them together before adding them to the white cement.

The method of laying these colored cement mortars in the design is as follows: First, enough water must be added to the dry mass to allow it to be mixed to the consistency of a thin paste. Then the design, which has already been cut out as previously explained, should be thoroughly wet down by sprinkling with a wet brush.

If a varicolored design is to be inlaid, it is always well to lay in all of one color at the same time, as is illustrated in Fig. 24. In this case we have figures *A*, *B* and *C* which are to contain the colors red, blue, and black, as indicated. First, with the aid of the blade of a penknife or any other handy tool according to the size of the work, lay the red cement in the design *A* as shown at *D* by the dotted lines. Let it come level with or even a trifle higher than the face or body of the vase or piece which is being inlaid; also let the colored cement project beyond its position in the finished design as indicated by the dotted lines. Now turn the vase around, and lay the red cement in the designs *B* and *C*, letting it project beyond its position as was done in the design *A*. The red cement which has been laid in the design *A* will now be set enough so that a straightedge made of a flexible piece of wood, or other material such as cardboard can be placed over it in the position of the finished design as indicated at *D* by the dotted lines.

The sharp edge of a knife can now be used to cut away the surplus cement which projects beyond the edge of the straightedge. In cutting away the surplus cement always cut away from the finished design. Proceed to cut away all other surplus cement from the other three sides of the design as just described and then in turn treat the designs *B* and *C* in the same manner. Now lay in the blue cement in all of the designs in a similar manner and then the black cement. If by chance any of the colored cements have gone beyond the designs and onto the face of the vase, scrape them off before they harden and then with the back of the blade of the knife, which is more or less blunt, run around the outline of the designs as well as between the colors, using a straight edge as a guide. By doing this a distinct parting line is produced between each color and a better effect can be obtained.

The colored cements which have just been inlaid must, of course, be cured so as to harden them up. This is done by sprinkling them with water as explained in a previous article.

The next article will treat of the making of ornamental relief work and how to cast it.

(To be concluded.)

THAWING DYNAMITE.

Dynamite must be carefully and thoroughly thawed, to make sure that it will explode and do good work. The proper thawing of dynamite is a simple operation, and is done safely. A dynamite cartridge can be lit with a match, and burned without explosion almost always. It must not be laid against a hot steampipe or smokestack, or be buried in hot sand, or stood near a fire. Use a heat that can be controlled, and that can never rise above 100 deg., even when neglected. Dynamite begins to undergo a change at 158 deg. F., and from that temperature up becomes more sensitive to shock, until at a temperature of about 356 deg. it will explode simply from that heat. The best thawer for dynamite is one in which the cartridges are in-

VASE WITH ELABORATE COLOR DESIGN.

COPY OF AN ANTIQUE.

A GOOD EXAMPLE OF COLORED CONCRETE WORK.

serted in tubes that are completely surrounded by hot water. The sticks may be carried to the work in this thawer. Never place the thawer over a fire, or try to heat the water while the dynamite is in it. For thawing on a large scale, a building heated with steam or water coil is good, provided primers, men, and tools are kept out.

AN ELECTROLYTIC RECTIFIER FOR CHARGING IGNITION BATTERIES.

BY FREDERICK E. WARD.

It is well known that small storage batteries, such as are used for automobile ignition, are very easily charged by connecting them to a direct-current house-lighting circuit through a suitable resistance, but where the current supply is alternating many have supposed that good results cannot be obtained without the use of complicated and expensive apparatus for converting the alternating into direct current. By following out the instructions given below, however, an electrolytic rectifier suitable for charging a six-volt sixty-ampere-hour battery from 110 volts can be made and used at home with small expense and satisfactory results.

There are two parts to the required apparatus—the autotransformer for reducing the voltage of the line from 110 to that required by the battery, and the electrolytic cell for rectifying the current or causing it to pass always in the same direction.

The autotransformer is shown by the drawings in Fig. 1. It consists of a single coil of magnet wire wound on a rectangular wooden spool, inside of which a bundle of steel strips is afterward placed to form a core. The spool is best made of well-seasoned white pine or whitewood, as these soft woods are readily obtained and easy to work. It is a good plan to dry the wood thoroughly in an oven before it is cut up.

For the body of the spool, four pieces 2 1/16 inches wide, 4 inches long, and not thicker than ¼ inch are required. These should be securely glued and nailed together so as to form a rectangular tube 4 inches long and measuring 1 9/16 inch by 2 1/16 inches on

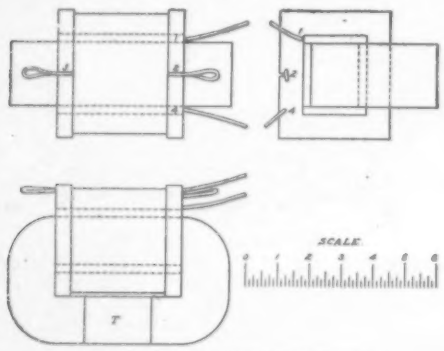


Fig. 1.—THE AUTOTRANSFORMER.

the inside. For the heads, two pieces ½ inch thick, 3½ inches wide, and 4 inches long are needed. Through the middle of each a hole about 2 1/16 inches wide by 2 9/16 inches long should be cut to fit snugly over the ends of the tube. When the heads are securely glued to the central tube, and braced by a few wire nails driven into them from the inside, the whole will form a strong spool having a space 3 inches long between the heads for the winding. The corners of the tube where the wire is to be wound must be well rounded off with a file, to avoid the difficulty of having to bend the first layer of wire around square corners. In one of the heads two small holes and a saw cut must be made as shown at 1, 2, and 4 in Fig. 1, while in the other head only one saw cut, 3, is needed. These holes and slots are for bringing out ends and loops in the winding, so that connections may afterward be made to different parts of the latter. On the heads of the spool the numbers 1 to 4 should be plainly carved to avoid confusion.

The coil is to be wound of No. 16 double cotton-covered magnet wire, of which about three pounds, all in one piece, will be required. This is to be wound on the spool in eight layers of about fifty turns each, as follows: First pass about 4 inches of one end of the wire out through the hole numbered 1, and then wind on six even layers like thread on a spool. The work can be done most easily by clamping the spool on the face plate of a lathe and turning it over slowly by hand as the winding progresses. It is well to give each layer a coat of shellac before winding the next. When the six layers have been put on, make a short loop in the wire at saw cut marked No. 2, and allow the loop to project outside an inch or so, as shown. Continue the winding as before, and at the end of the seventh layer leave a similar loop at saw cut No. 3, and finally finish by putting on the last, or eighth, layer and passing the end of the wire out through hole No. 4. After the winding is complete it should be protected from possible injury by a covering of two or three layers of cloth fastened with glue or shellac.

The core is to be made of strips of thin sheet iron or sheet steel cut two inches wide. One sixty-fourth inch is a desirable thickness, but anything less than 1/32 inch will answer. About eleven pounds will be needed for the core, in strips of different lengths varying all the way from 11 up to 21 inches long. Insert the strips into the hole through the spool one by one, putting in the longest ones first at the side nearest where the terminals are brought out, and finishing up with the shorter pieces at the opposite side. Enough strips should be used to fill up the hole

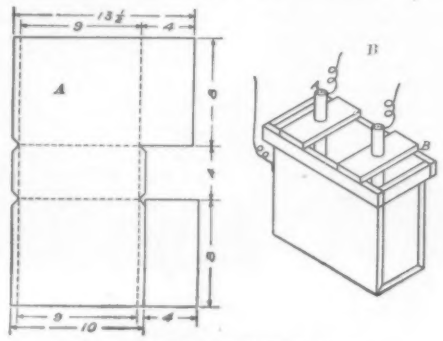


Fig. 2.—THE SHEET-LEAD TANK.

snugly. If the strips are rusty it will not be necessary to insulate them from each other, but if they are clean and bright it is a good plan to insert an occasional strip of paper so as to divide the core up into groups of half a dozen sheets each.

The strips must next be bent around, one at a time, so that their ends meet at the side of the coil opposite the terminals. Trim off the ends of each strip with a pair of tinner's snips so that they meet without overlapping, forming what are known as "butt joints." Care should be taken that the successive joints do not come in the same place, but overlap each other about two inches as they pile up, in the same way as the joints in brickwork. After the ends are all in place, they may be held permanently by wrapping them with a layer of stout cord (not wire) as shown at *T*, Fig. 1. This completes the autotransformer, though a coat of black paint will improve it.

The electrolytic cell consists of a lead tank nearly filled with a suitable liquid in which are immersed two rods of aluminium supported by a light wood frame, as shown in Fig. 2.

The tank should be made of sheet lead not less than 3/32 inch in thickness. A good size is 4 inches wide, 9 inches long, and 8 inches deep. Fig. 2 indicates how a piece of the sheet lead 14 by 20 inches may be used most economically. Cut out the two pieces as shown, fold on the dotted lines so that the joints lap on the outside, and solder the seams heavily with ordinary solder. Do not try to use a lead-lined wooden tank, as the success of the apparatus depends largely on the cooling effect of the surfaces exposed to the air.

For the electrodes, two round aluminium rods ¾ inch diameter and 6½ inches long are required. These must be of commercially pure aluminium, and not the so-called "hard stock" or alloy. Fasten to one end of each rod a piece of No. 16 copper wire to serve as a terminal. The best way to do this is to drill a small hole through each rod near one end, and then insert the wire and drive down the aluminium with a center punch until the wire is tightly pinched. (See Fig. 2*A*.) The tank itself also serves as an electrode, so that it is necessary to solder a wire to it somewhere on the outside. The aluminium rods are best

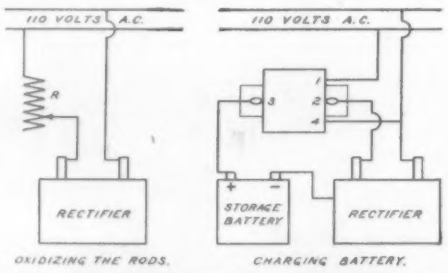


Fig. 3.—METHOD OF CONNECTING UP THE RECTIFIER.

supported in the tank by means of a light wooden frame made of six pieces as shown at *B*, into which the rods may be clamped by thin wooden wedges driven in where they pass through the holes.

To make up the liquid for the cell, put two pounds of crystallized sodium phosphate in the tank, and fill up the latter with about one gallon of lukewarm (not hot) water or enough to fill it to an inch from the top. Stir with a stick until the salt is dissolved, and then adjust the aluminium rods so that they dip into the solution three inches.

Before the apparatus can be set at work the rods must be coated with a film of oxide. This has to be formed by the alternating current itself, for which purpose the rods may be temporarily connected to the 110-volt power mains as shown in the first diagram in Fig. 3. A resistance, *R*, of about ten ohms must be used to prevent too much current from passing at first. After half a minute this resistance may be gradually reduced to zero, and the operation will be completed.

For actual service the autotransformer, rectifying cell and storage battery are to be connected up as shown in the second diagram in Fig. 3. The autotransformer may be connected to a 110-volt lamp socket by means of a sufficient length of No. 16 lamp cord and an attachment plug. A two-ampere fuse should be included in the circuit.

The windings of the autotransformer have been so proportioned that when connected to 110 volts about 2½ amperes will flow through a six-volt, sixty-ampere-hour battery. This low rate of charging contributes to long life of the battery, and at the same time minimizes the amount of attention necessary in charging, since an overcharge at low rate does very little harm. With ordinary use of an automobile, a ten-hour charge over night every two weeks will keep the battery full and in good order.

After about fifty or sixty hours' use of the rectifier the sodium phosphate solution will become exhausted. This will be indicated first by unusual heating of the tank and autotransformer, due to leakage currents, and finally by the blowing of the main fuse and possibly the discharge of the battery back through the tank and coil. It is therefore necessary to make up a fresh solution for the tank and reoxidize the rods after about fifty hours' use, or when excessive heating is first noticed.

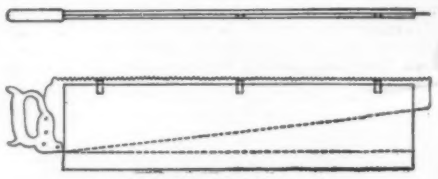
The aluminium rods last a long time, and when the lower ends become worn thin they may be inverted if care be taken to remove every particle of the copper connecting wires.

The apparatus will charge an eight-volt battery, if necessary, but at a slower rate, and it can also be used on a four-volt battery in an emergency. In the latter case the large currents may soon cause overheating unless a resistance of about one ohm be connected in series with the battery.

SAW-FILING CLAMP.

BY C. A. PITKIN.

The saw clamp, described by Mr. Bayley in the Scientific American of May 15th, is of service in the workshop, and I should like to submit a modification



HANDY SAW-FILING CLAMP.

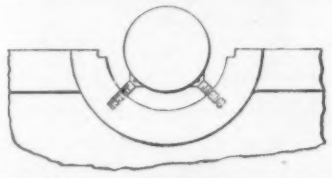
of it, as used by carpenters and others, when the facilities at hand are limited.

Oftentimes when one wishes to file a saw, while away from the shop, and having no filing clamp at hand, he is at a loss to know how to firmly hold the tool during the operation. A handy expedient is to take a board or joist and turning it on edge, end on, make a cut with the saw to almost its depth. Then place the saw in the cut, teeth uppermost, and drive in several small wedges along one side. This always holds the saw nicely, and the whole may be nailed to a step, sill, or part of the framing, or may be placed in a carpenter's vise. To loosen the saw, strike the top of its handle with the hand.

TO SUPPORT SHAFT WHEN BABBITTING.

BY J. EDWIN KERR.

This is a suggestion for the simplification of the babbitting of crankshaft boxes, which has been used a number of times with entire satisfaction. Drill two holes about ¼ inch from the outside end of the box and in about the position shown in cut. Tap the holes for small screws. Let the shaft rest on the head of these screws, which may be adjusted until the shaft is lined up. After lining the shaft it may be taken



SUPPORT FOR SHAFT WHEN BABBITTING.

out of the box and warmed before pouring the babbitt, preventing the metal from being chilled and forming an uneven surface. The shaft may be replaced while warm and the babbitt poured at once, the screws insuring a perfect line-up. The screws may be removed with a screwdriver when the babbitt has been poured, or they may be left in if brass screws are used.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

MILKING-MACHINE.—L. L. STORY, East Fairfield, Vt. The object here is to produce a machine which can be readily adjusted in position. While the invention concerns itself with the general construction of the machine, it relates also to the construction of the teat cups and the manner of actuating them in the milking operation.

ATTACHMENT FOR CORN-CULTIVATORS.—H. J. NEFF, Stanford, Ill. In the present patent the invention is an improved cultivating implement designed and adapted to be used as an adjunct or attachment of a cultivator having plows or shovels for use in furrowing between rows of young corn stalks growing in hills or drills.

Household Utilities.

PORTABLE GRATE.—W. H. BOLLAND, Savannah, Ga. The invention is an improvement in fire-place grates, and has in view a grate of the conventional or other design, hinged at one side to swing within and to the outside of the fire-place opening, in which latter position it is adapted to be lifted from its hinges and removed for emptying or other purposes.

BROOM HANGER.—J. H. ASHMEAD, Silver Bay, N. Y. An object here is to provide a hanger by means of which a broom can be hung in an inoperative position from a nail or other support, which serves as an additional means for holding the broom straws securely together on the neck of the broom, and is so constructed that the nail cannot become caught in the broom straws to loosen or otherwise injure the same.

ROCKER FOR CHAIRS.—G. M. STRATTON, Carthage, S. D. The purpose of the invention is to provide hollow rockers of sheet metal for chairs, which are light, strong, shapely, and can be produced at low cost. It consists in a novel construction of rockers and their combination with the legs of a chair.

Machines and Mechanical Devices.

SHUTTLE MECHANISM.—J. LARSEN, Silkegade 13, Copenhagen, Denmark. The present invention concerns a horizontal shuttle, which is so arranged that it seizes the thread and holds it fast, so that the needle can without stopping go straight down and then again at once straight up, the upper edge of the ring-formed shuttlebed being provided with a horn, that holds onto the thread during the formation of the stitch.

APPARATUS FOR MANUFACTURING CIGARETTES.—O. WARTMANN, 681 High Road, Tottenham, London, England. The chief object of the invention is to enable the production of cigarettes which, while formed to a large extent by means of automatically acting mechanism, shall be free from the defects of ordinary machine-made cigarettes, and shall exhibit some of the best characteristics of those made entirely by hand.

BUTTER-SERVER.—O. W. MOBERG, Seattle, Wash. The construction enables the empty butter dishes to be stacked in a column and removed one at a time filled with butter and ejected from the machine. It stops the action and locks movable parts in case of breakage of the wire used for cutting the butter; prevents the stock of butter from moving in the machine except for the purpose of filling a butter dish; provides for effecting the disengagement of butter dishes from the bottom of the column of such dishes, and provides refrigeration and storage of the stock to be used so as to maintain the butter in suitable form to be acted upon by the machine.

DUMPING-SCOW.—F. P. EASTMAN, New York, N. Y. The scow has movable sides normally securely locked against opening, and which can be readily opened without presenting obstructions to the load, thus insuring a complete and quick discharge of the load, especially when the latter consists of bulky and moist refuse liable to cling to any obstructions in its path. The invention relates to scows described in the Letters Patent of the U. S., formerly granted to Mr. Eastman.

CENTRIFUGAL SEPARATOR.—J. A. B. DOMINGUEZ, Guayama, Porto Rico. The invention admits of general use, but is more particularly applicable to the separation of sugar and molasses from the crude product known as masse-cuite, or in other words, from the material received from the evaporators. Centrifugal force is developed in a rapidly rotating body, and causing such body to exert increased pressure, if its direction of motion is suddenly reversed.

Prime Movers and Their Accessories.

ROTARY ENGINE.—F. P. NICHOLS, Houston, Texas. In this patent the invention makes an improvement in rotary engines. In operation the motive fluid being admitted through a hollow shaft, passing upwardly through radial slots, and through ports to pressur. chambers, acting against the sides of the piston blades to rotate the motor, which comprises the shaft, the casing, and the piston blades.

LUBRICATOR-PUMP.—G. J. ARENDS and J. J. ARENDS, Rock Rapids, Iowa. The invention relates particularly to such pumps as are employed in the cylinder lubrication of heat engines, in which a reciprocating plunger, playing in an oil pumping cylinder, operates in conjunction with a kinematic element of the engine. Continuity in the oil feed to the pump; the preheating of the oil to be delivered to the pump; and expedients in the regulation of oil delivery, are assured.

Railways and Their Accessories.

KNUCKLE-JOINT CONNECTION.—M. KELLY, Bloomington, Ill. The invention refers to pivotal connection between the connecting rod and the parallel rod of a locomotive, and the aim is to provide a knuckled joint connection, arranged to hold the pivot pin tight and to properly press the jaws to prevent lost motion and uneven wear.

RAILWAY-TRACK CONSTRUCTION.—J. H. F. SCHULZE, New York, N. Y. In this patent the invention is an improved construction of railway tracks and has for its purpose the provision for the easy removal and replacement of the head of the rail, which is the only part worn, without interfering with the rail connection with the road bed.

RAILWAY-SWITCH.—P. MCGRATH, Denver, Colo. The present embodiment of this invention comprises a plurality of switch-throwing devices arranged on each side of the switch, a locking device for locking the device in thrown position and for insuring its complete throw, and a hand operating device which normally is disengaged from the switch.

CAR-COUPLING.—H. C. CRIGGER, Memphis, Tenn. This coupling is of the Janney type. In operation, when the parts are coupled, the operating bar will be in its outermost position and its serrations will be detached or out of interlocked engagement with serrations of the tongue. If the bar be now moved inward, it will first lift the locking dog to uncoupled position and then will move into interlocked engagement with the tongue of the coupling hook and will throw the hook to open position.

Pertaining to Recreation.

BILLIARD-CUE.—L. KÁLMÁNOVITS, New York, N. Y. The improvement pertains to cues, and more particularly cues having removable tips, means for securely and removably mounting the tips in position, and if so desired, between the tips and cue, a body of resilient material, which increases the effect of the blow when the cue strikes the ball.

Designs.

DESIGN FOR A SPOON, FORK, OR SIMILAR ARTICLE.—H. P. ROGERS, Albion, Ind. The ornamental design presented is an interesting administration design including the representation of an opossum at one end of the handle, a boll of cotton on the other end, and a sweet potato intermediate its ends.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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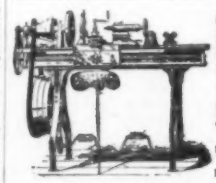

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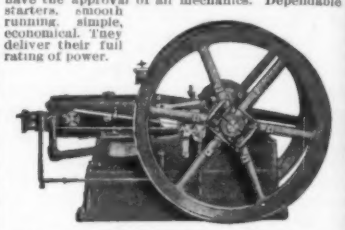

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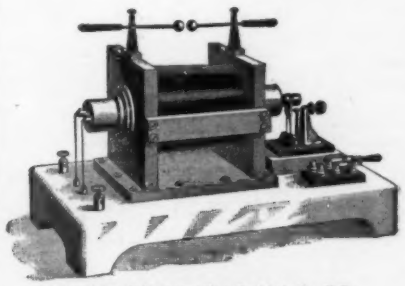
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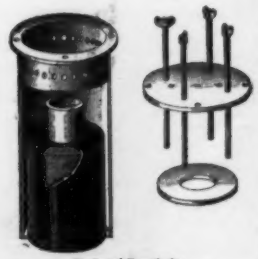
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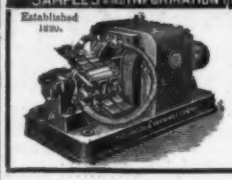

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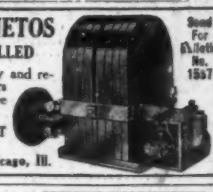

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